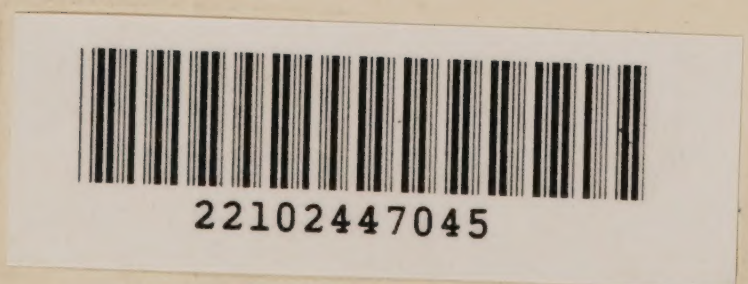
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TRANSACTIONS

OF THE

Odontological Society of Great Britain.

VOL. XXVIII.—NEW SERIES.

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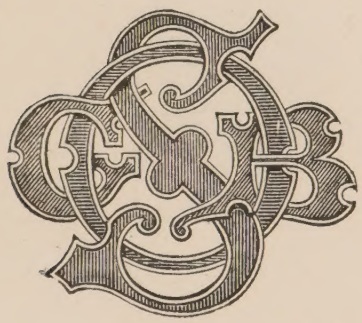
OF THE

ODONTOLOGICAL SOCIETY

OF

GREAT BRITAIN



VOL. XXVIII.—NEW SERIES.

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Odontological Society of Great Britain.

ORDINARY MONTHLY MEETING.

November 4, 1895.

Mr. DAVID HEPBURN, L.D.S.Eng.

President, in the Chair.

The Minutes of the last meeting were read and confirmed.

The following nominations are before the Council. As resident members:—Frederick Lawson Dodd, L.R.C.P. Lond., M.R.C.S.Eng., L.D.S.Eng., 41, Wimpole Street, Cavendish Square, W.; Walter S. Nowell, M.A.Cantab., L.D.S.Eng., 41, Wimpole Street, Cavendish Square, W. As non-resident members: — Ernest Catt, L.D.S.I., D.D.S.Mich., 11, Valley Bridge, Scarborough; W. F. Cornelius, L.D.S.Eng., 29, Orchard Gardens, Teignmouth.

The following gentleman was proposed as a non-resident member of the Society:—Henry Bambridge, L.D.S.I., 27, King Street, Great Yarmouth.

The following were elected non-resident members of the Society:—A. W. W. Hoffmann, L.R.C.P.Lond., M.R.C.S. Eng., L.D.S.Eng., 30, The Parade, Leamington; James Sim Wallace, M.D., B.Sc., 29, St. James' Road, Kingston-on-Thames.

The following having signed the necessary obligation forms were admitted members of the Society :—William Jarvie, 105, Clinton Street, Brooklyn, New York ; Ernest H. A. Mackley, 74, S. Giles' Street, Norwich ; John W. Tomlinson, 8, Warrior Square, St. Leonards-on-Sea.

The President said he had very much pleasure in bringing forward a recommendation made by the Council. It was customary occasionally to confer one of the few honours they had at their disposal upon old members of the Society who had served the Society well and had retired from practice. Mr. Balkwill had found it necessary to retire from active work and also from the membership of the Society. The Council recommended that Mr. Balkwill, in consideration of his many services and long membership extending as far back as 1861, should be elected an honorary member. The resolution was carried by acclamation.

The Librarian announced the following additions to the library :—"Dental Materia Medica and Therapeutics," fourth edition, by James Stocken, revised by Leslie M. Stocken and J. O. Butcher, presented by the authors; *Guy's Hospital Reports;* the *Transactions of the Royal Medical and Chirurgical Society;* and the "Calendar of the Royal College of Surgeons of England," in exchange.

Casual Communications.

(1) *Ptosis of Dental Origin.*—Mr. Main Nicol described a case of ptosis associated with and apparently caused by a dental lesion ; it occurred in a young lady aged 25, who in June of the present year consulted him for severe unilateral facial neuralgia. She had suffered intermittently for more than a fortnight from attacks of pain commencing in the bicuspid region, and extending backwards to the angle of the jaw, upwards to the temple, and down into the neck, so that, as she described it, "the whole side of her face ached." The pain, she stated, was usually at first slight, dull and heavy, then became throbbing and even-

tually indescribably acute. These seizures varied in intensity and duration, with uncertain intervals of comparative comfort, and were most erratic in their onset-though the patient volunteered the information that exercise or sudden changes of external temperature seemed to excite them, and that they also often came on at night; their duration varied from a few minutes to two or three hours. But what chiefly attracted attention was the half closure of the right eye, with pupillary dilatation and flushing of that side of the face. The patient stated that in one of these neuralgic seizures, more than usually severe, the pain had compelled her to close this eye, and that she had been unable to open it fully since. The condition of the left eye was normal, while that of the right was as follows: the eyelid was only half raised, so that when vision was directed horizontally forwards, the upper half of the eyeball was covered; when the patient attempted to open the eyes widely the right lid lifted scarcely at all, while the left eye responded naturally. The pupil was moderately dilated (about one-third of a diameter wider than its fellow), and reacted very sluggishly to light, though with accommodation and to consensual stimulation it responded almost as well as in the left eye. The conjunctiva and lid were also affected in that they shared in the hyper-vascularity of that side of the face, the congestion of the palpebral conjunctiva being specially marked. Vision was not tested; the patient said that it appeared as usual except that in a bright light she could not see well with the right eye, probably owing to the failure of the iris to contract.

Examination of the teeth revealed only three small fissure cavities in the crown surfaces of the right upper and lower third molars; in two of these cavities probing brought on the neuralgic pain. They were intensely sensitive, and excavation was only possible after the injection of cocaine hydrochlorate hypodermically into the surrounding gum; the cavities were then filled with oxyphosphate. The patient reported herself on the following day as much better, though the ptosis remained unimproved; three days later she had completely recovered, the lid and pupil having

recovered their natural mobility, and no recurrence of pain had occurred. Fourteen days ago she reported herself as being quite free from pain and ocular trouble.

Taking everything into consideration, Mr. Nicol was inclined to the view that it was a purely functional, a *soi-disant* hysterical condition, although the medical attendant stated that the patient was not particularly neurotic, and had never shown any neuro-mimetic tendency.

(2) *Fracture of the Maxillary Tuberosity during the Extraction of a Second Molar Tooth.*"—Mr. Main Nicol also read notes of a case in which the maxillary tuberosity was fractured during the extraction of a second upper molar. The accident was presumably rare, as he had been unable to find any account of a similar occurrence.

Ten months ago H. R. C., medical student, aged 20, consulted him in reference to the left second upper molar, which had been the cause of considerable pain; it was the most posterior tooth of the series on that side, the third molar being unerupted, and was greatly broken down, the pulp projecting as a polypoid granulating mass, while acute periodontitis rendered any manipulation very painful. It was decided to remove it, the patient, however, mentioning that any teeth he had already lost were removed with difficulty, as their roots were exostosed. Nitrous oxide and oxygen being administered, an attempt to extract the tooth was made, but unsuccessfully, the more exposed part of the tooth crumbling up in the forceps; a second trial was made, the blades being applied outside the alveolus, and the tooth was removed, though it required great force to withdraw it from the socket, even when quite loose; as it came away, it was evident that some extensive solution of continuity had taken place. Hæmorrhage, somewhat free at first, soon ceased, and it was found that there was a vertical fracture of the body of the superior maxilla, reaching buccally higher than the reflection of mucous membrane from alveolus to cheek, and extending higher lingually than the palatine process, passing behind the posterior border of that structure; the gum was correspondingly torn. The posterior fragment gave one the

sensation of being united to the main portion of the bone above, round its point of connection, to which it worked as on a hinge. It was mobile in every direction, but all movement except anteriorly was accompanied by pain. Crepitus was very distinct, the patient himself detecting it when swallowing or touching the fragment with his tongue; when swallowing he also compained of a sensation like "sore throat." There was backward displacement of the posterior fragment to the extent of about a quarter of an inch, but without any interference with hearing. The roots of the tooth were united into one mass by pathological cementum; and it seemed probable that the walls of the socket had undergone thinning *pari passu* with the radicular hyperostosis, thus predisposing to fracture. On anatomical grounds one must suppose that the antrum was opened, but no attempt was made to ascertain this.

Treatment consisted in the application of a splint and the frequent use of antiseptic mouth washes. The splint was made of metal, clasping the six-year molar, and extending posteriorly as a pear-shaped curved plate, the narrow part crossing the line of fracture, so as to permit free drainage, while the wider curved portion retained the posterior fragment in apposition with the anterior very efficiently. The subsequent course was uneventful; some deep-seated tenderness on pressure over the malar bone was noticed on the third day, and gave rise to a suspicion of suppuration in the maxillary sinus, but this did not occur; one or two minute sequestra were spontaneously extruded between the ninth and twelfth days, and on the eighteenth day the splint became loose and was removed. The third molar was erupting beneath it, and as union was moderately firm the splint was not replaced. When the patient was seen three weeks ago union was perfect, and apparently osseous, the wisdom tooth fully erupted, in good position, and separated from the first molar by a space not greater than one-sixteenth of an inch.

Mr. F. J. Bennett asked if inquiry was made as to the probability of influenza being the cause of the first case mentioned by Mr. Nicol. It might seem far-fetched, but

he thought if they were to go into the matter it would be found that a great many of these obscure cases could be fairly traced to epidemic influenza. He had two cases in the summer in which there was severe neuralgic pains which, with slight headache, were the only symptoms. The patients were both quite unable to get about and had to be kept in bed. The teeth were perfectly free from caries, periostitis, or any local symptoms. They both yielded to antipyrin, getting perfectly well without any local treatment whatever. It was quite possible that the flushing of the face, the unilateral neuralgic pain and the ptosis might quite well be put down to influenza. At any rate, it was a thing well to keep in mind, so that in the event of other methods failing, they might try some such drug as antipyrin, given in ten-grain doses at first, and then five-grain every half hour until the pain was relieved. If the heart's action was at all weak a teaspoonful of brandy given every half hour would counteract any depressing effect of antipyrin.

Mr. Albert said he thought Mr. Nicol's explanation was entirely satisfactory. He had a case of a lady who had ptosis, and was requested, much against his wish, to take out a tooth; but there was no doubt in his mind that the extraction of the tooth had nothing whatever to do with the ptosis, although it disappeared in a week. The fact of the dilatation of the pupil was good evidence enough that the hysterical affection was at the bottom of the difficulty. He believed he was right in saying that during the pain the pupil was generally contracted. He believed that Mr. Nicol was perfectly correct in attributing the cause to hysteria, but he would ask whether there was a possibility as to its being a case of temporary diphtheritic paralysis.

Mr. Vanderpant thought in the case mentioned by Mr. Nicol that if the tooth had been split the roots might have been removed without fracture of the alveolus.

Mr. Matheson said he had a somewhat similar case which he had brought before the Metropolitan Branch of the British Dental Association. In that case the fracture occurred in the extraction of the sixth-year molar. The

patient was a boy about twelve, and as the second molar was coming down he wished to make more room for it. The sixth-year molar was not a good tooth, and had to be removed. Being extremely firm it was extracted under gas. When it came away it was found there was a fracture of the maxilla. The case corresponded almost exactly in appearance to that mentioned by Mr. Nicol. The boy gave a sudden spasmodic movement just as he was applying the greatest force that could be safely applied, and it was just then that the fracture occurred. Gas being again administered he was able to press the fragment into position. It went very comfortably into its place, and seemed to be so firmly settled that it was not thought necessary to put on a splint. The boy was at school and was told to come again if he had any trouble. He did not see him until the end of the term, and then everything was perfectly quiet and safe, and he could trace no history from the boy of there having been any trouble. This was satisfactory, but it showed how, even in extracting a tooth so far forward as the sixth-year molar, one must be prepared for an occasional occurrence of that kind.

Mr. Nicol, in reply, said in the case of the young lady, he had made enquiries of her medical attendant but he could give no history of influenza. With regard to the possibility of diphtheritic paralysis, there was nothing at all corresponding to that. With reference to the other case, he was sorry he had not the tooth to exhibit, but he did not think splitting it would have been an easy operation. It would certainly have taken far more trouble and possibly would have done quite as much harm as the extraction.

Mr. Boyd Wallis presented a series of models showing supernumerary teeth : also a model of the case of a boy who suffered from a growth at the back of the nose. He said some few months ago Mr. Harding gave a Casual Communcation upon perchloride of mercury. No discussion then took place, and he should therefore like to read a note he had made on the subject.

"A great deal has been said and written upon perchloride

of mercury as an antiseptic in the treatment of the teeth, and the discoloration which is supposed to follow its use. When I was in practice in the south of France some twenty-five years ago, it was the custom to embalm the bodies of foreigners who died there prior to their removal for burial elsewhere, and the process consisted in injecting into the arm an aromatic fluid containing a strong solution of perchloride of mercury; by this means the body was perfectly preserved, so far as my experience goes, both as regards antisepticity and colour. A body which I had assisted to embalm I saw some three months after this process had been carried out, and the results were entirely satisfactory. These results led me to test perchloride of mercury in the treatment of the teeth, and for this purpose I have no doubt as to its value, but unfortunately its use is too often followed by acute pain, but the pain I have always found to gradually decrease and pass away.

"Two other important objections to its use have been raised; first, that it is a powerful coagulant of albumen, and therefore useless for our purpose. It certainly does coagulate albumen, forming a mercuric albuminate, but that does not appear to reduce its antiseptic properties, for it is quite evident that when used for embalming purposes it has the property of permeating the tissues to an extraordinary extent, and the result we get with the perchloride treatment of the teeth is further evidence of this, for it is not at all uncommon to find in from two to ten days after its application to dead teeth that intense pain follows, showing that whether coagulation has taken place or not, the mercuric salt has penetrated the tooth. The other objection is as to discoloration of the teeth which is supposed to follow its use. I certainly have seen discoloration succeed its application, but was this due to the perchloride, or was it the natural sequel to a dead pulp? I have here some of a number of specimens which I have tested in solutions of perchloride (acid and neutral) of various strengths, for different periods of time from two to many months, and they do not appear to have changed colour in the least. One only containing a filling has turned green, probably from

the formation of a chloride of copper by the union of the ammonium chloride with the copper of the amalgam. Perchloride has this advantage—its antiseptic power is not, like that of so many other antiseptics, destroyed by admixture with organic matter.

"I have kept small animals, birds and snakes for many months by injecting them with a solution of perchloride.

"The "kyanizing" process for the preservation of timber consists in impregnating it with perchloride of mercury, and here coagulation takes place in the first instance.

"If a mercuric albuminate is formed it probably re-dissolves in course of time, and absorption then takes place. It is soluble in an excess of albumin, or in chloride of sodium. I may mention one out of many cases which I have treated it is that of a badly decayed and abscessed upper lateral of one of my sisters, which I treated in the autumn of 1873. As I was at the time about to leave for Biarritz I simply cleared the cavity, filled the pulp chamber with a paste of perchloride and an essential oil on cotton wool, and roughtly filled the tooth, with the intention of doing something more to it on my return to England; but on seeing the tooth again I found it doing so well that I left it alone, and this tooth gave no further trouble until 1892 when my sister became very much broken down in health, and then another abscess formed and the tooth was extracted.

"As the perchloride is so irritating in its action it is a question in my mind whether we shall not find the double cyanide of mercury and zinc better for our purpose, as it is less irritating and a powerful antiseptic; $\frac{1}{10000}$ part of the salt has been found to preserve blood serum free from organic development, in spite of inoculation with septic fluid.

"In cases of severe pain already existing, I treat the tooth in the first instance with iodised phenol (iodine 1, carbolic acid 4) with a little cocaine and menthol added.

"Another preparation perhaps worthy of notice is the *biniodide of mercury*. Dr. Pietra Santra has found that a rabbit injected with a solution containing two milligrammes of biniodide and a sheep with five milligrammes

were preserved for several months, the meat being in a perfect state of preservation."

Mr. REINHARDT said he should like to ask Mr. Wallis the cause of discolouration resulting from the use of Miller's tabloids—the compound of the sublimate and thymol. His experience was that the teeth became distinctly greyish in colour. He found in the case of a young lady, although no amalgam was used, that the first bicuspid in the upper jaw for about an eighth of an inch below the gum turned a dark green colour. In that case the perchloride was used, but no amalgam—simply gold and cement. He should like to know how the discolouration arose.

Mr. WALLIS said that sometimes they got discolouration in pulpless teeth, no matter what was used. He did not know that he had ever seen any special discolouration from the use of perchloride.

Mr. SAUNDERS exhibited a form of scaler which he had found of some use. The handles were roughened, they were larger than the old pattern, and the instrument was very much shorter from the handle to the blade. It had the advantage of giving a firm grip, and bringing the point of the instrument nearer the fingers, so that they had the thumb and the third and fourth fingers on the teeth. He also exhibited a finishing file which he had found useful. It was made thin so as to enable the file to pass between teeth which were not much divided, and the angle was a little varied, so as to meet the case of teeth which were irregular. He had found it very useful in the case of irregular bicuspids where it was otherwise difficult to get at a distal filling.

The PRESIDENT then delivered his Inaugural Address.

INAUGURAL ADDRESS.

Gentlemen,—In occupying the chair of The Odontological Society of Great Britain this evening for the first time as your President, it is not my intention to deliver to you a lengthy introductory address. Indeed I would willingly forego the ordeal altogether, and at once proceed to the more important business of the session, but in a wisely conservative Society such as this, it would ill become me to depart entirely from a time honoured custom. Bending, therefore, before the inevitable, I crave your indulgence for a few minutes.

At a recent banquet given by this Society, Sir William Flower, whom we have the privilege of numbering amongst our honorary members, made pleasant reference to the hereditary principle displayed in our list of Presidents, and it is a remarkable fact that in thirty-nine Presidential years, no less than six sons of former Presidents have been chosen to fill the chair. This, I venture to say, is a wholesome and healthy sign, indicating that the good traditions of the Society are not likely to die out; and when we consider the fact that each has been elected on his own merits, and by the voice of the whole Society, we need not fear that any illnatured charge of nepotism can be laid at our doors. Another point of interest in our Presidential list is the fact that four gentlemen have been twice elected to office after considerable intervals, so that the links with the past have been thus further strengthened and maintained. History also at times repeats itself. It

fell to my father, during his Presidential year, to represent the Society at the funeral of Mr. Arnold Rogers, of honoured memory, who was so largely instrumental in bringing this Society into existence, and who ruled over its destinies with such fostering care during its earlier days; and to me, your present President, came my first and I trust saddest official duty of representing you, when the great father of our profession, Sir John Tomes, was laid in his last resting place. This is not the time or place to speak of the mighty work done by him. We, as members of this Society, whilst mourning his loss, have only to feel grateful that he was spared to a ripe old age, that he was able to see in great measure the results of his unostentatious but never-ceasing labours, and that he left us crowned with all the honours that a grateful profession could bestow.

In the memoir of this great man which has recently appeared in the pages of the *Journal of the British Dental Association*, we trace his guiding spirit throughout all the onward steps of our professional progress, and let us hope that even a fuller history of his unrivalled career may yet be forthcoming to quicken and encourage those who continue to carry on the great work in which he took so active a part, and to inspire all the future members of our specialty with the full dignity and responsibility of that profession of which he was so bright an ornament.

As the older friends of the Society pass away, and no less than sixteen of our former Presidents, and many honoured original members, are no longer with us, the ranks of the Society have been filled with not only a second, but I may almost say even a third generation of dentists, and to those of the original stock who remain, it must indeed be gratifying to see the Society founded by them on so sure a basis ever increasing and prospering, and becoming year by year more and more firmly established amongst the scientific societies of the land.

Although a matter of comparatively recent history, so rapid has been the progress of dental surgery in this country that our later members may hardly realise how much the present position of our profession is due to the influence and actual initiative work of the Odontological Society in past times. I must therefore be pardoned if I briefly remind them of it.

In the decade preceding the formation of our Society, weary and disappointing, vague and unsatisfying must have been the efforts of those high-minded practitioners who realised the burning necessity of some steps being taken for the consolidation of the profession and the future education of the dentist.

The natural reluctance of the College of Surgeons to take to itself a specialty little practised, less appreciated, and for the acquirement of which no recognised educational system existed, not unreasonably suggested to the minds of many that a solution of the difficulty might be found in organising a separate institution, which should be to dentists what the College of Surgeons was to surgeons. A few there were who considered that a medical or surgical degree with a little special technical knowledge picked up subsequently at haphazard, summed up the needs of any who desired to practise the specialty, at the same time ensuring a certain degree of respectability. But luckily there existed those who saw further into the future, who realised from their own dearly bought experience the full needs, educational, ethical, and political, of the dentist; who believed that while special education and training of a comprehensive character were an absolute necessity, at the same time association with an established medical or surgical body was the only means by which dentistry could be safely raised from its then chaotic condition and firmly established, as it deserved to be, as an integral portion of the great healing art.

The struggle between opposing factions was a hard one; but happily for us, the wiser heads, although in the minority, prevailed. After many and mature deliberations the Odontological Society was established in 1856, and soon, by force of reason, won over even its most stubborn opponents; then all worked together for the common weal. One of the earliest undertakings of the Society was the foundation of the Dental Hospital of London and London School of Dental Surgery. It suggested a curriculum in which prominence was given to the requisite training for the attainment of special technical experience and the necessary manipulative skill, combining with these a sufficiency of anatomical, surgical, and general medical knowledge. Thus prepared, the College of Surgeons was once more appealed to, and this time not in vain.

The history of the granting of a Royal Charter which empowered the Royal College of Surgeons of England to institute a department in dental surgery in the year 1859, is too well known to dwell upon, but we must ever feel proud to recall the fact that our Society sowed the good seed that has since fructified so richly. If any course other than that adopted by the great pioneers of dental reform and founders of this Society, who by their exertions linked us indissolubly with the Royal College of Surgeons, had been followed, I venture to say the Dentists Act at this date would have loomed only a dim phantom in the distant future, or a consummation devoutly to be desired, but hopelessly unattainable.

Thus it is impossible to dissociate the Odontological Society entirely from dental education and political progress, but in the phenomenally rapid evolution of which it was the germ, other organisations have developed, whose peculiar province it is to watch over these things. The Society, therefore, has leisure to quietly pursue its own

ends. It is indeed a pleasant resting place in the still turbulent life of a young profession, for dental politics have no longer any place in it; science alone holds sway. It has been likened by an honoured leader of modern time to a still oasis, where the wicked cease from troubling and the weary are at rest. Long may it remain so.

I do not for one moment mean to imply that the Society is inactive, far from that. It has done a great work in the past and it has a great work before it in the future; indeed in one way it is capable of exercising even a wider influence than any other existing dental institution. One important feature is the fact that it is the chief medium by means of which odontology is brought into immediate contact with kindred sciences. Again, it forms a common debating ground for vexed questions on points where general and dental pathology and practice meet, as many invaluable papers by leading medical men read and discussed at our meetings can testify. The interchange of our publications with those of learned societies at home and abroad, is a feature also which must not be overlooked. With regard to our own intrinsic recorded work, this has always been accessible to the profession, and few, if any, subjects relating to our specialty have been left untouched by the Society. Our lengthy series of Transactions evidence this, and I feel sure the perusal of these in leisure moments will clearly show, better than anything else, the sure and steady advance of dental science during the last nine-and-thirty years.

That the Society might do something in the way of endowing research is a point I refer to with delicacy. On the question of its desirability I have no doubt in my own mind, but we must not lose sight of the fact that although a wise and careful policy in the past has enabled us to accumulate a small reserve fund at this epoch, we know that ere long a large demand may be made upon it. Our

home is but temporary, and although our child, "The Dental Hospital of London," has up to this time been able to treat its parent with leniency, there is no saying what may take place when the present premises have to be abandoned. I, therefore, during my term of office, shall feel bound sacredly to harbour our resources, none the less hoping that in the near future the Society may be in a position to expend adequate sums for the encouragement of investigation and research, and also for the still further improvement of our unique museum, and the extension of our library.

Meanwhile, I believe we shall not lack material on which to base our discussions, for new pathways of experiment and inquiry are daily unfolding themselves in the ever-broadening plain of modern dental science, and we may rest assured that the voluntary work which has not failed us in the past will continue to be our portion in the future. Our voluntary work will, I believe, always be the best—if undertaken, as Sir James Paget once said, when addressing an audience interested in dental surgery, "by high-minded men, who resolve that the work to which they give themselves for their profession's sake shall be done in the best possible way, with a constant tendency to advance higher and more high."

There are, however, lines of research which cannot be carried through without considerable outlay—vexed questions, needing for their solution the laboratory and its appliances; questions which might be worked out by young enthusiasts, of which our profession claims not a few, possessing the time and the ability, but lacking the means, and it is in this direction that the Society will do well ere long to turn its attention and lend its aid. In doing so it will but be following in the wake of older societies, which have already found such a course expedient and useful.

Since the last meeting of the Society the world of science has lost two of its greatest lights—Pasteur and Huxley. The stupendous and revolutionising work of the former will probably be more fully realised by future generations than it is by ourselves; but with the latter, Professor Huxley, we are in closer touch, for he was a keen odontologist, and, moreover, an honorary member of our Society. His interest in the progress of dental science was evidenced some years ago when, amidst his multifarious duties, he found time to preside at the annual distribution of prizes at the Dental Hospital of London and deliver a lengthy address full of wise counsel and sage advice. To this great man it is proposed, under the auspices of the Royal Society, to promote a national memorial—a project which this Society, of which he was so distinguished a member, will, I am sure, be proud to support.

I have referred to these two distinguished scientists because I feel the lesson of their lives is one which all those who cultivate the pursuit of knowledge, even in the humblest way, may well take to heart.

And now, gentlemen, I am conscious I shall be acting most in accord with your feelings if I bring my brief remarks to a close, especially as my honoured predecessor, Mr. Canton, has left me a legacy in the form of an adjourned discussion, which will more profitably occupy a considerable portion of the time at our disposal this evening. It only remains for me, therefore, to thank you most heartily for the honour you have conferred upon me by electing me to preside over you. This honour and your kindness I appreciate to the full. I am aware that, in an introductory address, according to prescribed usage, I might have devoted considerable space to apologies for my own unworthiness, but so self-evident a fact I have been pleased to pass over without notice. As your chosen

President for the year, my time and services, such as they be, are entirely at your command, and with my able secretaries, helpful Council, and your never-failing support, I have no fear but that the work of the session will be profitable and useful, not only to ourselves, but also to the profession at large.

Adjourned Discussion on Mr. Cunningham's and Mr. Sidney Spokes' Papers on "The Immediate Regulation of Teeth."

The Secretary read the following letter on the subject received from Mr. W. Hern :—"I regret I am unable to come to the Odontological meeting to-night, but as I have treated a few cases of instanding front teeth by the immediate method, I think it well to send you the models of one of the cases which is to my hand. The teeth of this little patient, which were immediately regulated, have been tried by the heat test since the operation, and they responded at once to it, thus proving the vitality of the pulps. Although I should deprecate immediate treatment in most, or even many, of the cases of instanding teeth which are brought to us, inasmuch as they can be treated in a less risky manner by more mediate methods, yet I think many of us see cases in which we are perfectly justified, under certain circumstances, in adopting the quicker method of correcting the deformity. If the patient be operated on before the teeth have fully erupted, and the operation performed without any downward dislocation of the tooth which is to be moved, the risk of killing the pulp is, in my experience, a small one."

Mr. Kirby mentioned the case of a patient over 30 years of age, in which an eminent dentist had taken some considerable trouble to reduce a deformity caused by an instanding lateral, but without much success. She had heard of the operation of luxation, and was extremely anxious to have it performed upon herself. The case was not completed beyond models showing the proposed opera-

tion being prepared. The model showed the cut going completely down the alveolus, almost to the extremity of the root of the tooth, and the tooth and alveolus together forcibly luxated outside the bite. In such a case he should say the probabilities were that there would be no necessity to use splints to retain the tooth in its place. It would go into position with a very small amount of force, and would be retained by the bite, which would prevent the tooth growing inwards again. If the operation was carried out, there could be no doubt that it would be a success. The worst that could happen would be the death of the pulp, but in all probability that would not occur.

Mr. J. H. Badcock said he had experimented in two cases since they last met. The first was a patient who came on September 3, a woman aged 27. On the right side the upper teeth were rather crowded, the canine being inside the bite of the lower teeth. There was a badly decayed lateral incisor paining her very much. That tooth was extracted. Having no convenient instrument at the time for making a saw cut, the rest of the operation was put off. The following week, having injected in front and behind the canine about a quarter of a grain of cocaine in 10 per cent. solution, he with a circular saw divided the alveolus between the canine and the central, and between the canine and the first bicuspid on the outside. He endeavoured to do the same on the inside, but owing to the position of the instrument could not work so well there. With the forceps shielded with tin foil the canine was then moved into position. As far as the pain went the patient assured him that she felt nothing whatever of the saw cut, but the pain of moving the tooth was much the same as in extraction—perhaps not quite so severe. He believed it could have been done painlessly if he had been able to inject more cocaine. Having done that, the tooth was secured with silver wire to the adjoining teeth. For the first three days the teeth were very sensitive, especially the central, which had the wire tied round it. The wire was removed, and since then the tooth had been retained in position simply by its position outside the bite. The ten-

derness soon passed away, and there was no sort of trouble from the first except the tenderness caused by the wire. A report about the case sent in last week stated that the tooth was alive, almost firm, and perfectly healthy. The wound in the gum had healed up. The patient said the tooth was a little sore for the first week, but no inconvenience was felt after that. When he last saw the patient himself three weeks ago the tooth was very nearly as firm as the other teeth.

The next case was that of a boy with two outstanding upper canines, two first bicuspids being carious, and on the right side an instanding second bicuspid. He gave gas, removed the two first bicuspids, and at the same time brought the second bicuspid out into line. That was tied with wire in the same way, attaching the wire to the canine, then on the inner side of the second bicuspid and round the first molar. There was no pain or inconvenience. The patient could not eat on that side of the mouth for a few days, but otherwise the tooth had done perfectly well. The operation was done about a fortnight ago. The tooth was not firm, but he had no doubt that it would be very shortly. As far as one could tell the tooth was alive, and there had been no trouble occasioned by the treatment. On October 25 the tooth was reported to be still slightly loose, but it was alive and in good position.

Mr. Cunningham said, knowing that Mr. Paterson had had some experience in this operation, he was very anxious that he should have been present. Unfortunately he had been unable to come, but he had sent some notes, leaving it to him to use them if he thought fit. He certainly thought fit, because they were not all successes, and in a new operation they must face possible failures as well as successes.

Since reading the paper he (Mr. Cunningham) had had the opportunity of operating in a lower case, of which he exhibited the models. It was not a very typical case, showing any great utility in the operation. It was a case of a lower jaw with the right incisors outside the arch, a matter really not of any great importance, but still there was a possibility of future difficulty, and as it was so simple an

operation, he thought it was worth while doing. In endeavouring to extract the central incisor, there being no opportunity of taking hold of it in the conventional way, it did not surprise him to find that it was fractured extremely low down in the socket. He incised the alveolus on each side of the tooth, and then taking the guarded forceps, pulled the lateral incisor forward. The models showed the tooth in its splints simply ligatured, and a second model showed that the gum had now completely healed over the fractured root in the anterior part of the alveolus, partly owing, he thought, to the more than usual vigorous way that the case was dealt with. He had brought with him a pair of Dr. Bryan's forceps. He (Mr. Cunningham) had never had an opportunity of testing the apparatus, but in certain cases, no doubt it would work well. Dr. Bryan had adopted the method of sectionising a portion of the alveolus, and, instead of trying to separate the alveolus from the tooth, he now believed it to be better to try to move the tooth with a portion of the periosteal and osseous attachment as well. Dr. Bryan was especially a supporter of the attitude taken by Mr. Spokes on this question, where he said it was peculiarly applicable to teeth in the erupting stage. In children, of course, the operation was much slighter and not attended with the same amount of risk as in the major operation as shown in the case of Mr. Russell, who was present on the last occasion. He brought the subject before the French National Dental Convention at Bordeaux, and he understood that some of those who had had the opportunity of seeing the exposition of the process at the Congress in Chicago had adopted this method of operating. He did not know what was their percentage of failures, but they spoke with the greatest enthusiasm of the success which had attended their results in experimenting in this direction. He regretted that he was not able to exhibit the photographs shown on the previous occasion, as they had been sent abroad. He also regretted that the editor did not think it possible to reproduce the photographs in the Transactions, because of the fact that they had appeared elsewhere. So far as he was personally concerned, he had more confidence in the operation than ever.

Notes of Certain Hospital Cases of Immediate Regulation of Teeth; under the Care of Mr. W. B. Paterson.

February, 1893.—Woman, 22 years of age, came for relief of toothache in a right lower first molar, which was carious and worn down to the gum level. Periostitis was present, and the tooth had been loose for over a week. The second bicuspid in front of this tooth was sound, but its position very irregular, viz., with its masticating surface at a right angle to the dental arch, and pointing towards the tongue. The tongue was indented but otherwise normal. The space between the first molar and the first bicuspid was equal to half the size of the second bicuspid's crown. Advice being given, and consent obtained, an anæsthetic was administered. The first molar was extracted, freer inward motion being used than was necessary for the extraction alone, in order to expand the alveolar wall. The tooth extracted, a fine straight elevator was inserted between its anterior socket wall and the second bicuspid, and the bone levered away free of that tooth. Then with a pair of forceps, the blades of which were sheathed with lead foil, the second bicuspid was grasped, and with steady motion drawn up to the vertical position. The alveolar walls were as firmly pressed together around the tooth as was possible with the fingers, and a temporary splint, made out of Stent's composition, was immediately moulded, horse-shoe fashion, to the inside of the lower teeth and surrounding, but not capping, the second bicuspid. The bicuspid, now upright, did not articulate with the teeth above by the thickness of a stout visiting card. A vulcanite splint replaced the Stent, and the patient was seen every week for six weeks, when she was discharged with the tooth firm, and not painful during mastication. She reported herself in six months; the splint had been left off since her last visit to the hospital. The second bicuspid was quite firm, its colour normal, and not painful in mastication. The articulation remained spaced as before mentioned.

1894.—In two other patients of the ages of 25 and 27 years similar operations were performed upon misplaced lower bicuspids.

In Case 2 (a woman) the roots of a lower first molar were removed and the misplaced second biscuspid immediately regulated. In doing so, although the regulating force was firmly and steadily applied, the root of the bicuspid fractured low down. The tooth, however, was brought up to the vertical position and splinted. It did not articulate above by the thickness of a sixpence. I saw the case at the end of a week, and there were signs of the tooth becoming firm, although it had a tendency to cant inwards on removal of the splint. It was painful to bite on. My colleague, Mr. R. C. Ackland, who saw the case with me, reported two weeks after an increasing firmness of the tooth, and less pain in the act of mastication with the splint in—a doubtful success in fact.

Unfortunately the case was lost sight of by reason of holidays intervening; but from failure in reporting it is possible the patient may have had the tooth extracted.

1895.—Case 3 (a woman). A lower first molar, carious, was removed, and a similar regulating *modus operandi* adopted. The result was a complete failure. The second bicuspid was, with much suffering, borne with for nine days; it was then extracted. A sequestrum consisting of the septum between the molar and bicuspid, together with a portion of the sockets of each, was afterwards removed. A splint had been in use; it was made before the operation, and easily adjusted after. The bite was free in Cases 2 and 3; no periosteal inflammation existed before operation, and the misplaced teeth were sound and firm. In all three cases the inward position of the bicuspids justified alteration in view of interference with the tongue. Case 3, indeed, came to have her tooth extracted on account of occasional lingual excoriation.

A fourth case of immediate regulation promises better. It is that of a lad who had an unsightly, spike-shaped supernumerary occupying the place of an upper lateral incisor, the incisor lying inside the bite, and close behind it.

The supernumerary was extracted, and the incisor drawn forwards into its socket space. But little traction force was needed, the septum being slight and readily yielding, *i.e.*, without much splintering sensation; waxed silk and collodion held the tooth firmly in position. The patient having little or no spare time, and being a printer's reader, a regulating plate was out of the question. He has yet to report.

Remarks.—The question of general utility of an immediate regulation operation is one that it is premature to discuss on the evidence adduced either by the readers of the papers, or in the cases above mentioned. From a very limited experience I would simply draw attention to the following points:—

(1) That under favourable conditions, *e.g.*, where the alveolus is softened by inflammation, whether pre-existent (Case 1), or purposely induced by an operation like a preliminary saw cutting, or the extraction of an adjoining tooth, there will be difficulties in the way of obtaining suitable space for the tooth to be regulated in, and a risk of failure afterwards from suppuration and necrosis.

(2) As operative details: forceps alone will not always suffice for the work, except as in Case 4, where the patient is young and the regulation easy. The risk of injuring the tooth by the instrument is a factor to be reckoned with, especially if the root is abnormally shaped, which may often be the case. Careful splinting suggests itself as important, and the gauging of the height of the bite, and also its adjustment after the moving of the tooth, is a matter requiring most careful attention.

Mr. F. J. Bennett said he had not had an opportunity of practising this operation, but it appeared to him that as developed by Mr. Cunningham it was a distinct advance on the earlier method. The introduction of the saw cut was scientific, and the fact of holding in view the importance of keeping intact the periosteum and the vascular

supply to the teeth was another great advance. If they could with a clean saw-cut divide the tissues, place them in a proper position, and keep the periosteum in good condition, they had a great gain on their side. Another point which occurred to him in reading over the paper, was as to the relations of the antral cavity with regard to operation on upper bicuspids or teeth in that region. If—as they knew—the roots of teeth frequently entered the antral cavity, then dividing the alveolus on either side in separating the bone they must in some cases break through the floor of the antrum. In such cases there must be a tendency for blood to extravasate into the antral cavity, and if so, would there be a tendency to septic inflammation? That was a thing which had always to be borne in mind. Another point was that the very cases which appeared to do best were not quite the cases most urgently demanding such treatment. The cases in which it would be best were those of adults in which the bone was hard, and in which regulating by plate would be a prolonged operation. Then as to the importance of taking a model beforehand, and doing a preliminary operation on the model; proceeding in that way they were quite sure that the bite was correctly adapted, and were perhaps relieved of difficulties, such as had been mentioned, which might otherwise follow. He hoped that they would keep an open mind in the matter, and not be eager to condemn an operation which might have a great future before it.

Mr. Matheson said that Mr. Cunningham in reading his paper spoke of the difficulties he had met with from the buckling of the saws that he used. He would like to ask what was the diameter of the saws he now used.

Mr. Albert said he thought that such cases as those adduced could scarcely be pronounced to be successes until a period of at least two years had elapsed. He mentioned a case of a child of 12 years old, in which, now some twelve years ago, having taken a model beforehand, he forced the instanding lateral incisor into position. It could hardly be called a success, because six months afterwards the tooth was extracted. There was no discolouration, but there

was sensitiveness. He showed the case at a post-graduate course, and it created some comment. Since then he had done the operation, though without the refinements that Mr. Cunningham had invented; that was to say, he had simply seized hold of the tooth with care and levered it into position. He could not say that he had ever seen a case go wrong. A fortnight ago a girl came to St. George's Hospital, aged 18, with the upper central incisor inside the arch. She was placed under gas and the tooth brought into position by the forceps. It was necessary, however, to wait some years before such cases could be pronounced successful. He would have brought the cases forward, but, as they knew, it was very difficult to get out-patients to attend. He hoped on some future occasion to have the opportunity of doing so.

Mr. E. Lloyd-Williams said that while he should be very loth to attempt to condemn an operation simply because it was new, he would venture to offer one or two criticisms upon Mr. Cunningham's very interesting communication. He was sorry that the operation had been treated in the paper more from the mechanical than from the surgical and pathological point of view, and he ventured to suggest that the interest would not have been detracted from had the larger aspect received fuller attention. New operations came in from time to time. They heard much some time ago about transplantation. A good deal of noise was made about it at the time on both sides of the Atlantic; but as far as he could understand it was not an operation which came to stay, and he personally had never yet seen a case. Two dangers in the operation now before them had been already pointed out; one was that they might possibly fracture the tooth, and the other that the pulp of the tooth might die. Either of these was a serious matter—especially in the mouth of a good-looking young lady, whose friends perhaps magnified the beauty of the patient rather more than the prosaic dentist was apt to do. It was not, however, to these two points that he wished to call attention, but would rather refer to one or two things which had not been touched upon. First of all,

there was an absolute danger of septic infection. This was a point which they dared not lose sight of, and if any serious surgical trouble were to arise in consequence of this operation, they would certainly repent—when too late—that they had not adopted perhaps a longer, but certainly a much safer, method. Mr. Cunningham had been privileged to describe a new operation, at all events in name. They had heard of *plastic* operations, but had now been introduced to *plaster* operations. One thing that struck him in connection with these plaster operations—and the models were very interesting—was that the contour on the alveolar surfaces had been very carefully restored, not by Nature, but by the hand of the gentleman who had manipulated the plaster. Did Mr. Cunningham think that Nature was going to restore the contour of these alveolar surfaces precisely in the same way? Take, for instance, a tooth which had to be moved, with its surrounding alveolus, one-eighth of an inch outwards, which was not a very extreme case. The alveolus might not show any very great depression on its outer surface at that point, but if they were going to move that surface one-eighth of an inch—in a slice, as it were—beyond the edge of the alveolus which adjoined it, he should like to know how it was suggested that the irregular surfaces resulting were to be transformed into a new contour. The same remark would, of course, apply to the inner surface. This was a matter which Mr. Cunningham would no doubt be able to clear up. With regard to the fragments themselves, there was one point which was made more interesting from the fact that Mr. Nicol, in a Casual Communication that evening, had ventured to proclaim the very heterodox pathological opinion that the union of a maxillary fragment which was fractured was a true bony one. He (Mr. Lloyd-Williams) had always been taught that union by bone never took place in the upper jaw. It was a matter which had interested him not a little; but though on the look out for specimens which might prove that this was, or was not, true, he had never come across a single case confirming Mr. Nicol's statement. He had had the opportunity of treating a few cases of

fracture of the upper jaw—though they were not very common—and had always been of opinion that there had been no new bone thrown out, and that the resultant union was a fibrous one. Mr. Cunningham would be able to give an opinion as to whether these fragments united simply by fibrous union, as they had always been taught to believe, or whether he thought with Mr. Main Nicol, that true bony union did take place.

Mr. Sidney Spokes said nothing had been advanced in the discussion against the little operation that he had mentioned at their last meeting. Of course there was a possible danger of fractured teeth with regard to the minor operation, but there was no such case yet on record. He had done several other cases since the last meeting, moving altogether sixteen incisors. He had not attempted any more canines, but he was sure it was a very simple thing to move the incisors. As to the after success, his cases were not sufficiently old to stand the time test suggested in the discussion, viz., two years; but so far as he could see, there was not the least doubt that the teeth were all alive and flourishing. He exhibited another series of models showing results of operations.

Mr. Humby said he wished to say a word in defence of what Mr. Cunningham had called the "classical" operation. Mr. Kirby had introduced a model, and was willing to risk his professional reputation in connection with an operation which had only at present been done in plaster, and he said that it had been a failure by the ordinary mechanical method in the hands of an eminent gentleman. Whoever the practitioner might be, he thought that he ought not to have failed, and that none of the cases which had been mentioned were such as could not have been regulated by the so-called classical method if properly applied.

Mr. A. E. Baker asked if Mr. Cunningham would move teeth inwards as well as outwards.

Mr. Cunningham said as he had pointed out in his paper, that was an operation he had never yet done, but which he was anxious to try. He had thought it all out, and on the

basis of his past experience had reasonable hopes of success. With regard to the question of danger, Mr. Lloyd-Williams had acted as the bogey man; he complained that the matter had been brought forward more in a mechanical than a surgical view. He (Mr. Cunningham), submitted that this was rightly called by Dr. Bryant the "surgical treatment of irregularities," whereas the older and practical method was the mechanical treatment. The dangers mentioned were a fractured tooth and a dead pulp. Mr. Sidney Spokes had forgotten the fact that in one of his operations on children an incisor was fractured, and no doubt it was a possible danger, and it was a point on which they must be careful. The operation must not be done in a careless and unscientific way. As to the death of the pulp, if it were the prettiest girl that Mr. Lloyd-Williams had ever seen, and if she had an instanding canine interfering with mastication, and if by a saw cut of the alveolus he could bring out the canine and free the bite from its wrong position, he would do it; because even if the pulp should die he could fill the tooth, and that devitalised canine, after proper root-canal treatment, would be a better tooth than the living tooth displaced and instanding. He did not depart from that position, and he did not shirk the question of the admitted danger. He had said nothing on septic infection, but he had described the precautions taken to avoid it. He admitted its possibility. In fact, one of the things that he feared was that some dentist would perhaps be led to proceed to this operation in cases where the teeth were incrusted with tartar, and the mouth reeking with bacteria and filth. That was not the condition in which to perform the operation. A man had no right to degrade a new operation by doing it in that way. He must first of all clean the mouth, and only perform the operation when it was in a proper condition. He had not the requisite knowledge to reply to the question proposed as to its being a fibrous or a bony union. He did not pretend to *know* anything about it, but his impression decidedly was that there was bony union. With regard to the contour question, Nature was no doubt the great artist in plastic operations,

and they would do well to leave very much to Nature. Mr. Paterson had spoken about the bite being short by the thickness of a visiting card or a sixpence. They could not of course ensure absolute articulation, but the thickness of a visiting card was not a very vital point, if the bite were freed. With regard to the circular saw, the one he had (seven-eighths of an inch) was really not deep enough to sectionise the alveolus as one would like, but if it were increased to an inch and a-quarter, there would be much greater chance of buckling. Mr. Kirby's suggestion was very valuable. It was not absolutely necessary to use the circular saw at all; one might have a frame saw which would effect the purpose equally well, if not so quickly. Of course it was perfectly evident that an inch and a-quarter saw must be thicker than a seven-eighths saw, and therefore it would not go so readily in between the teeth as the fine saw, but he believed it would go fairly well. Mr. Humby had referred to the classic operation. They could not get over the fact that the regulation of the teeth by the older mechanical means had sometimes failed, and failed at an enormous cost to the patient. Here the new operation came in, and without wishing to press it as a method of treating all irregularities, he put it forward as a new operation, enabling them to treat cases which hitherto they had not been able to treat successfully; and further, in the case of children, especially of the poorer class, it afforded a means of treating a large number of cases which would otherwise go untreated, to their lifelong detriment.

The PRESIDENT tendered the thanks of the Society to Mr. Cunningham and Mr. Spokes, as well as to those who had brought forward Casual Communications.

Odontological Society of Great Britain.

ORDINARY MONTHLY MEETING.

December 2, 1895.

Mr. DAVID HEPBURN, L.D.S.Eng.

President, in the Chair.

The Minutes of the previous meeting were read and confirmed.

The following nomination is before the Council:—Harold Dewe Matthews, L.D.S.Eng., Grove Field Villa, Cheltenham (non-resident).

The following gentlemen were proposed as resident members of the Society:—Frederick Lawson Dodd, L.R.C.P. Lond., M.R.C.S.Eng., L.D.S.Eng., 41, Wimpole Street, Cavendish Square, W.; Walter S. Nowell, M.A.Cantab., L.D.S.Eng., 41, Wimpole Street, Cavendish Square, W.

The following gentlemen were proposed as non-resident members of the Society:—Ernest Catt, L.D.S.I., D.D.S. Mich., 11, Valley Bridge, Scarborough; William Fergus Cornelius, L.D.S.Eng., 29, Orchard Gardens, Teignmouth; Edmund Lewis Dudley, L.D.S.Eng., 14, The Circus, Bath.

The following gentlemen having signed the obligation book were admitted members of the Society by the

President :—Messrs. Francis R. Flintan, Frank C. Porter, James Sim Wallace.

The following gentleman having signed the necessary obligation form was admitted a member of the Society :—A. W. W. Hoffmann.

The Librarian announced the following donations to the library :—"The Diseases of Children's Teeth—their Prevention and Treatment," by R. Denison Pedley, presented by the author; "The Common Crow of the United States," by W. B. Barrows and E. A. Schwarz; and the purchase of Richardson's "Practical Treatise on Mechanical Dentistry," fourth edition.

The President said Mr. Todd, of Brighton, had presented to the Museum a portrait of M. Dechement, the inventor of mineral teeth. He, the President, was interested in the picture and also amused at the rather flowery verse in French which appeared underneath. In looking over his library to see if he could find any works by the author, whose name was of course well known, he had found a book containing a portrait which was identical with that of the picture.

Casual Communications.

Mr. Charters White said a short time ago in the Transactions of the Society a request was made for specimens of old bone work for presentation to the Museum. He had had one set in his possession about fifty years, and another about thirty, and he should be very happy to present them.

The first was a set worn by Turner, the artist, and gave a very good idea of the way in which they made teeth in those days. Turner was a very economical man, in dental matters especially—the race was not extinct now—and having lost four teeth in the centre he sent to the dentist whom he employed for a piece of what was called in those days "granulus," the soft part of an old cow's tooth. He fitted it in himself and filed it up roughly, so that it really showed some of Turner's own work. He thought it might be interesting for the Museum. The other set showed an

example of natural teeth inserted into bone. It belonged to a roaring old Irishman, named Dr. Clark, whose appearance with these teeth reminded one of a gorilla. The lower part of the face was very prominent, and these teeth did not add to his beauty. It was a specimen of the way in which natural teeth were inserted in bone at that period.

Another specimen showed what was considered a very handsome set from a carved hippopotamus tooth. The patient in that case would not have them carved up in the proper way with molars, incisors, and canines, but he wanted double teeth all round, and it would be seen how difficult it was to make them articulate. Afterwards he had another set made, and as he (Mr. Charters White) did not care for the carving of hippopotamus teeth he made him a vulcanite plate; but that would not do unless he inserted in the front three rows of flat mineral teeth, which gave the gentleman great satisfaction.

The PRESIDENT said they were very much indebted to Mr. Charters White for his very valuable additions to the museum. As time went on such specimens became rarer and rarer, and he hoped that any of their members who might have specimens would send them to the Museum, where they would always find a home.

Mr. H. L. ALBERT presented a model illustrating the case of a young man, aged about 25, who, when 12 years old, fell out of bed and completely displaced an upper central. He was taken to a dentist the next morning, some eight hours afterwards, and the dentist replaced the tooth after filling the root with gold. Being taken home in a hansom the tooth was jolted out; he was taken back to the dentist, who replaced it, and used ligatures to retain it in position. The tooth did very well but never grew. For fourteen years the young man retained it in his mouth, and about a month ago brought the crown of the tooth, which was a mere cap of enamel, all the dentine being absorbed. An interesting point about the case was to know how the dentine was absorbed. In the centre, occupying what was normally the root canal, there were some fair-sized granulations, and the patient said that one or two

loose pieces of soft gold had come out. He was inclined to ask the question whether it was possible that chronic periostitis had resulted in granluation tissue finding its way into the pulp canal, thus absorbing the dentine, or whether the root had become absorbed. He did not think the root had become absorbed; in fact, on looking at the crown of the tooth there were evident signs of fracture.

The PRESIDENT said the case was a very interesting one, especially as to the arrest of development which had taken place. In a case which came under his own notice a child met with an accident by which two of the incisors, a lateral and central, were knocked out. They remained out of the head some thirty-six hours and were replaced by the dentist, and retained by the regulation plate she was wearing at the time. He had the opportunity of seeing that child some four or five years after the accident, and the distinct arrest in the progress of the dead teeth was very peculiar. The other teeth had grown and assumed a normal articulation with the lower incisors, but the teeth which were replanted had been quite arrested in their development. Whether absorption of roots had taken place he could not say, because they were still firm.

Mr. W. B. PATERSON said some specimens of teeth, prepared by John Hunter, would be found in the College of Surgeons Museum, in which vertical sections had been made through the cone; and in the root, they would see growing up cockscomb tissue. Mr. Albert had asked whether granulations might not have grown up into the root of the tooth. Probably they had, it being very similar to the specimen to be seen in the College of Surgeons Museum.

Mr. E. LLOYD-WILLIAMS thought there could be no doubt of the fact that granulation tissue did grow up into the pulp canal. He had a specimen in his own possession showing this distinctly.

Mr. HUMBY thought there was another explanation; that sometimes where gold was inserted in a root, absorption would take place of the root tissue leaving the gold projecting from the end of the root as a point, and producing irritation.

Mr. Albert said he could only imagine that the granulations found their way into the apical foramen, for the obvious reason that there was a hole there. There were evident signs of fracture. Moreover, it was broken simply by the muscular action of the lip, not fractured in biting.

The Foreign Secretary then read a communication sent by Dr. Miller, of Berlin.

The Transparent Zone in Decay of the Teeth.

By W. D. Miller.*

At the ordinary monthly meeting of the Odontological Society of Great Britain, held May 6, 1895, Mr. F. J. Bennett presented the results of investigations concerning the nature of the transparent zone occurring in connection with caries of the teeth, which, in his opinion, seemed to justify the conclusion that this appearance is due to nothing more than a partial decalcification of the dentine. Mr. Bennett bases his conclusion upon the fact that enlarged and thickened tubes might be demonstrated in the transparent parts. This result is diametrically opposed to that obtained by Walkhoff, who has spent a great deal of time in the microscopic examination of transparent dentine, and has invariably found a diminution in the diameter of the fibrils as well as in the calibre of the tubes.

Likewise Wellauer speaks of cases in which there is a contraction of the lumen of the tubuli, as well as of the fibrils, while, according to Baume, the contraction goes so far as to bring about a complete obliteration of the tubuli.

We are able to account for this marked difference in the results, on the supposition that in reality, in one case of transparency we may have expansion, and in another contraction of the tubules; or, that the material examined by Mr. Bennett was different from that used by others; or, that, finally, the results obtained by examination under high powers of the microscope may sometimes be misleading on account of the various refractive powers of the walls of the tubules in different conditions.

* Illustrations are unavoidably held over until next issue.—Ed.

It is not my intention, however, to approach the subject at the present time by the aid of the microscope, but rather to bring up some other points, which appear to me to be well worth considering:—

(1) If the transparent zone in dentine is nothing more than a partial decalcification which occurs alike in living and in dead teeth, then it should, apparently, be a very simple matter to reproduce it artificially; up to the present, however, no one has succeeded in doing so.

(2) Where decalcification of the dentine takes place, as in caries, the process advances in a fairly regular line (see slides 1 and 2), so that if we remove the softened dentine from a cavity of decay, we have a smooth, regular, concave surface. We sometimes find, it is true, the margin between the decalcified and the hard dentine irregular and jagged, but scarcely, I think, to such an extent as the inner border of the transparent zone. And in particular do we never find narrow bands or spurs of decalcified dentine extending quite to the pulp chamber, as we see them in the transparent zone (see slide 5 and photograph 1).

(3) Where acid acts upon the dentine at any point, as in a fissure, we find the decalcification extending laterally as well as in the direction of the dentinal tubules, and, in fact, almost, if not quite, as rapidly in the former as in the latter direction. Should we not therefore expect to find the transparent zone, if due only to decalcification, on the lateral margins as well as toward the pulp chamber? As a matter of fact, in the great majority of the sections which I have recently examined, where the transparent zone is due to caries alone, I do not find it appreciably broader than the broadest diameter of the decalcified territory, and I think we may say that, as a rule, the transparent zone is wanting on the lateral margins (see slides 6, 7, 8).

The points referred to under 2 and 3, I consider to be of minor importance, yet still deserving of notice.

(4) I have already, in another place, given expression to the conviction that the transparent zone does not form in dead teeth; this conclusion is based upon the examination of a large number of teeth, which had been worn on plates

in the mouth. At that time I simply split the teeth and noted the appearances to the naked eye. I have recently ground sections from about a dozen different teeth worn on plates, and send some of them for your inspection (slides 9 and 10). I found no transparent zone in the specimens which I examined. At least, I doubt if the appearances presented by the cuts can be called analagous to those seen in caries of living teeth. I think we should, moreover, bear in mind that the presence of a slight transparency in preparations from dead teeth does not furnish evidence of the non-vital origin of the same, since the transparency may have been present at the time the teeth were put on the plate or pivot. We know that a microscopic defect of the enamel surface, scarcely visible to the naked eye, may be the cause of extensive transparency of the dentine. These teeth sometimes show a slight diffuse transparency, extending over a large area of the section (as in slide 9), but having no connection with caries or any other apparent pathological process. I think that this, however, may readily be distinguished from the transparency which we are at present considering. One specimen shows two parallel stripes of transparent dentine, one just beneath the enamel border, and the other separated from it by a dark zone about 1 mm. in width. These are appearances with which we are all familiar, and which in my estimation result neither from vital action nor decalcification. In the cut just referred to, the inter-globular spaces are evidently the cause of the zone appearing double. I am inclined to believe that diffuse transparency may be only the result of a slight difference in structure, causing a difference in the permeability of the dentine, or of differences in thickness, &c.

It may be of interest to note in passing, that the majority of the teeth examined show penetration of the dentine by the fungus which I described in 1882* as Saccharomyces mycoderma, and which has subsequently been noticed by Galippe, Gorbard, Rudas, Tomes, Mummery, &c.

(5) We find typical cases of transparent dentine in places

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* *Archiv. fur experimentelle Pathologie*, Bd. xvi.

where the action of acids from without appears to be entirely excluded. Leaving the transparency of the roots of senile teeth out of account, we find transparency in cases where the enamel of the cusps has been worn down, even though the dentine may not be exposed thereby, and no trace of caries present (see photo 2). I have seen a well-marked case of transparency in a molar, in which the enamel of the approximal surface had been slightly worn away by friction against its neighbour. I send some specimens for your inspection in which there is pronounced transparency of the dentine extending quite to the pulp, with nothing whatever to account for it except the irritation caused by a crack in the enamel (slides 11, 12).

(6) Chemical analysis does not give results which are consistent with the theory of decalcification. Some years ago I made an analysis myself, and had another made by a Berlin chemist, Dr. Jeserich. Teeth were chosen in which there was but a superficial defect in the enamel, split through the defect and the pulp chamber, so as to expose the transparent cone of dentine. The latter was burred out with a very fine round burr, avoiding the parts next to the enamel margin, where there was any indication of decalcification. The powder was treated with a magnet in order to remove any possible particle of iron, dried at 102-105° C. and the ashes determined. My analysis gave 71·9 per cent. ashes, while normal dentine from the same teeth gave 72·1 per cent., a difference quite within the limits of the errors of experiment. The analysis of Dr. Jeserich gave for transparent dentine 69·5 per cent., for normal dentine from the same teeth 68 per cent. These results do not indicate any decalcification. The material was, in each case, obtained from about twenty teeth.

(7) The action of colouring matters upon transparent dentine is not what we should expect if a partial decalcification were present. It is well known that sound dentine does not readily stain with most of the dies commonly in use, such as carmine, eosine, &c.; partially decalcified dentine, on the other hand, takes on stains very readily. I have found an aqueous solution of eosine a valuable means

of diagnosing the presence of slight decalcifications. If a drop of strong mineral acid (nitric, hydrochloric) acts upon ivory for a single second, a subsequent application of the eosine solution will immediately produce a bright red spot where the acid came in contact with the ivory. A minute drop of a 1 per cent. solution of acetic or lactic acid will bring about a sufficient decalcification in twenty seconds to cause a deeper staining with the eosine solution. So, too, we find carious dentine becoming deeply stained by eosine. If now transparent dentine represents a partial decalcification, should we not expect it also to stain more readily than normal dentine? This is, however, not the case; on the contrary, we find the transparent dentine even more difficult to stain than the normal (slides 2 and 5).

In view of all these facts, some of which are of minor, others of vital, importance, I find it impossible, at present, to accept the decalcification theory of the typical transparent zone found in caries and other pathological conditions of the teeth as illustrated in the cuts which I have sent.

There are still some phenomena connected with the transparent zone, to which I may hastily call attention. We often find the zone of transparent dentine in beginning caries bordered on each side by opaque stripes, which, under the microscope, appear almost black, and within which the tubules are seen to be filled with irregular, angular granules or rod-shaped elements. These opaque zones we find almost constantly in some way associated with the transparent zones, usually separating the latter from the normal dentine or filling out the space between the transparent zone and the pulp (slides 13, 14, 15, 16).

In many cases we find the opaque zone where we might expect the transparent zone; a striking example of this in slide 17. In the wearing down of teeth by mastication I have found cases of transparency, more frequently, however, broad opaque zones, as in slide 18. The appearances are such as to give rise to the question whether the opaque zone may not be a forerunner of the transparent zone. Although the fact that we find transparency where there is

but a slight abrasion of the enamel (photo 2) and opacity where it is completely worn away (slide 18) appears to point to the opposite sequence.

Photo 2 presents a phenomenon to which I wish to call particular attention. On the right may be seen a transparent cone, which has resulted from a defect in the enamel, caries from the centre of the grinding surface has encroached upon the transparent cone, and yet the latter seems, to a slight extent at least, to have maintained its integrity, as indicated by its taking on the stain less readily than the adjacent parts.

These notes are by no means intended to give an exhaustive treatment of the subject; on the contrary, I must acknowledge that for myself the question appears more complicated and is farther from a definite solution than I thought it to be some months or even years ago. My only excuse for presenting them at the present time is, that the other side of the question may be heard in connection with the communication of Mr. Bennett.

Mr. F. J. Bennett said he wished to thank Mr. Mummery and also Dr. Miller for the privilege accorded to him of looking over the paper and examining the specimens before the meeting. He gathered from the paper that Dr. Miller objected to the proposition that the area of translucency was due to "partial decalcification of the dentine and nothing more." That was not at all the position that he (Mr. Bennett) took up in his paper; from first to last there was not an allusion to "partial decalcification and nothing more." The fact was the term was used not by himself but by a subsequent speaker. His point was to disprove the vital theory, and to clear the ground of this difficult subject by first showing what it was not, that they might subsequently find out what it was. Dr. Miller said that hard ground sections of dentine presented the appearance recognised, because the tubes being filled with air had a certain index of refraction which differed from that of the intertubular tissues. Anything which would bring the refractive indices nearer together might produce translucency; this might occur in one of two ways—either

by a decalcification, or by increased calcification. Dr. Miller said that in the zone of translucency a decalcification most assuredly did not take place, and added that this was sufficiently proved by chemical analysis. What was this chemical analysis? Dr. Miller stated that he took from twenty teeth the translucent areas and submitted these to chemical analysis. The ashes from the translucent areas came to 71·9 per cent., whereas ordinary dentine submitted to the same analysis yielded as ashes 72·1. Dr. Miller started to prove that there was increased calcification, and this was the result: 71·9 in the translucent zone—positively smaller than in the normal dentine, which was given as 72·1. He gave a second analysis made by a Berlin analytical chemist, who found that there was 69·5 in the translucent zone, and 68 in the ordinary dentine. Dr. Miller objected to this last analysis as too low, and doubtless it was so. It was quite evident, therefore, that Dr. Miller did not take this as a fair analysis, but relied upon his own, and he (Mr. Bennett) thought that Dr. Miller was convicted upon his own evidence. To return for one moment to the optical appearances. Assuming it was an increased calcification, imagining for a moment that the tubule instead of being filled with calcified matter was the reverse, they would expect the optical appearances of translucency to vanish instantly. One specimen in particular, accompanying Mr. Bennett's own paper, showed the typical pipe-stem appearance in the translucent zone, and obviously there, there could have been no calcified fibril. Did the appearance of translucency change? Not in the least; it was exactly the same. To jump from the calcified condition to an opposite one, *i.e.*, the pipe-stem enlargement, without any change in the optical appearance of translucency, was most conclusive that there could not originally have been an increased calcification of the fibril. Dr. Miller found dark tubes also in the translucent area. That, he (Mr. Bennett) would quite admit, but in specimens which Dr. Miller had shown, following up the same tubes from the carious area down to the pulp, they found the translucent area, dark tubes, again translucent area, and then the pulp. What utility was served

by this? By the dark tubes he meant that they were patent when dried, but occupied by a soft fibril in the fresh state. It was not conceivable that nature would calcify one little piece, leave a large margin uncalcified, and again set up calcification. No effective barrier would then be formed for the prevention of caries, and that was what was held by those who advocated the increased calcification theory. He would now pass on to the question of natural teeth mounted on plates. Dr. Miller had examined several specimens, and had sent two. He (Mr. Bennett) exhibited three specimens, each of which he claimed to show the translucent zone pretty clearly. With the permission of the President, he would hand round photographs of two of these specimens. In one it was almost incontestable that the translucent zone appeared in these teeth mounted on plates. It was admitted, of course, by the "vitalists," that if it could be proved that there was a zone connected with caries, even in one specimen, the downfall of that theory was inevitable, for it was inconceivable that vital action could take place in a dead tooth. Dr. Miller had alluded to saccharomyces mycoderma as a micro-organism which permeated these dead teeth. He did not doubt it for a moment. He believed that teeth mounted on plates did not decay exactly as ordinary normal teeth did; it appeared to be rather a spreading and somewhat shallow decay. Quite possibly this saccharomyces mycoderma might arrest the caries to some extent, especially as Dr. Miller said his own experiments were now and then vitiated by such development, which arrested the artificial caries he was attempting to produce. That might modify these specimens and was not an unimportant point. Dr. Miller had mentioned a case in which there was transparency of the dentine, without anything to account for it but cracks in the enamel. He could quite conceive that to be so, but that did not prove that it was due to increased calcification. Again Dr. Miller alluded to the attrition of caps of enamel, and said that he got translucency in those cases also. According to the specimens of attrition shown that evening they also equally found, in

some cases, black tubes which represented patency of the tube, and therefore that did not show that there was increased calcification even in attrition. He would refer to the very significant communication made recently by Mr. Tomes in which he actually found in teeth much worn down by attrition, not an increased calcification, but a result which, by chemical analysis, gave ·5 per cent. less than normal — that is to say, 71·4 instead of 71·9, which was the normal percentage of lime salts. That was rather a staggerer for those who believed there was increased calcification in attrition. Coming now to the stains, Dr. Miller had used eosin, for, as had been explained, on applying lactic acid or acetic acid to normal dentine he found that a portion became stained after the part had become decalcified. He further mentioned that the translucent zone did not stain with eosin. That might be so in the generality of cases, but he should like to point out one rather contradictory fact which Dr. Miller in his candour had stated. In specimen No. 2 he actually pointed out the non-staining by eosin in a specimen in which translucency occurred, as he considered, in response to attrition; and a little way off caries had attacked that translucent zone, and although obviously it must have decalcified the zone, eosin did not effect a stain. That showed that eosin did not always stain the decalcified tissue. Dr. Miller had further alluded to the researches of Baume and other continental writers; for the opposite view he might have adduced Drs. Black, Wedl, Lieber and Rottenstein, and many other investigators; but it was idle to quote one against the other. Points two and three, as to the shape of the spurs, and as to the translucent zone not taking the same contour as caries, were, as Dr. Miller admitted, minor points. It only remained for Mr. Bennett to thank the members for so patiently hearing him, and to express the hope that in anything he had said he had not gone beyond the retort courteous.

Mr. Mummery said he did not think Dr. Miller considered that this matter was in the least degree decided, but looked upon the cause of the translucent zone as still

quite a matter of investigation. He thought that the evidence of decalcification was very weak indeed, and the evidences of calcification were not very strong; but the evidence *against* the theory of decalcification he thought was very strong. He thought Dr. Miller had misunderstood Mr. Bennett as saying that the transparent zone was due to decalcification and that alone; it probably arose from the discussion which took place afterwards. The dark zones were not at all understood. Cracks through the enamel were strong evidence that the zone was not due to decalcification, because there was no caries and no opportunity for any acid to get to the dentine. As to the stain, No. 2 showed plainly a red stain encroaching upon the transparent zone, and so far as softening had gone on the red stain appeared to have penetrated. With regard to the chemical analysis this was almost a case of hair splitting, the differences were so very slight. He had written to Dr. Miller on the subject and received this reply:—"When one makes a number of experiments relating to any subject he always takes the mean of the results obtained as being most probably nearest the truth. He never takes out one result which best suits his view and neglects the other. The gist of my argument in my present article, as well as in my book, is that these analyses prove non-decalcification and are compatible with the vital theory. I do not say that they prove the vital theory, but they agree with it, in contradistinction to the decalcification theory. Besides, taking only one of the analyses, a difference of ·3 per cent. does not seem to prove that there has been a decalcification. The difference may be quite within the limit of an error in the experiment."

A Few Practical Points.

By L. Matheson, L.D.S.Eng.

My old friend, and our indefatigable secretary (Mr. Clayton Woodhouse), having cajoled me into making a foolish promise, I am here to-night for the fulfilment of that promise. I have, I regret to say, nothing to offer you in the shape of original research, or new methods of practice. All that I have to present for your notice are one or two considerations in respect of some practical details of everyday work. Just as, when one or two of us meet for a chat we compare notes as to our experience and discuss our personal preferences for different ways of attaining the same end; so I have ventured to enumerate a few points concerning instruments and materials, which may possibly be not quite ancient history to all of you, and which, at all events, may, I hope, raise the spirit of discussion.

To begin with, there are one or two forms of probes, which I should like to mention. They are not new shapes, but they are so little used that it seems worth while pointing out their value.

One is a form of instrument that I prefer to any other for the examination and definition of roots more or less hidden, and of the cervical margins of labial cavities extending below the edge of the gum.

The straight, tapering shank is bent upwards at a very slight angle, for about a quarter of an inch, and then downwards for an inch, at an angle of 45 degrees. This instrument is, I venture to say, much more handy than that ordinarily sold, for the latter is too nearly rectangular, and does not sufficiently clear the anterior teeth in the examination of posterior roots, especially when the teeth stand high, and the roots are low in the gum. This probe is not blunt, but pointed—a very unorthodox shape, I know; but I must confess that I find the point much more effectual than the dull edge of the usual form.

The second kind of probe is one that is tapered to a fine point, and is quite straight, except at the extreme tip, which is bent at a right angle to the shaft, for the length of a sixteenth of an inch or less. Similar instruments are a pair of curved probes, of the form commonly used, but having the rectangular tip of the one just mentioned. These three shapes are invaluable for discovering hidden approximal cavities, and for dropping into the marginal flaws of fillings,

which produce such different emotions according to whether the filling is of one's own or of somebody else's insertion.

Passing from probes to rubber dam, I would say a word—as I never lose the chance of doing, in season and, I fear, out of season, too—in favour of the use of FERNALD'S DAM HOLDER. The wire frame which goes by this name—or rather, a slight modification of it—I have now used for some years, to the entire exclusion of retractors of any kind; and nothing would induce me to return to the old-fashioned method, finding, as I do, that the wire frame so very markedly diminishes the discomfort of one's patients when the rubber is used.

The discomfort of one's patients is diminished in three ways. In the first place, the frame, to a large extent, does away with the bridled gagged feeling that the retractor produces. In the second place, the rubber not being drawn closely against the cheeks, moisture does not pass by capillary attraction on to the skin of the face, and one gets rid of the slimy, messy condition of things so common where retractors are used. In the third place, no band being required round the back of the head, the necessity no longer exists of having to bring into close contact with one person's head the elastic or tape that has been in close contact with other people's heads.

Taken separately, these advantages may look small; but taken together, and in practice, they are far from insignificant; and, indeed, in my opinion, they are so considerable as quite to outweigh the inconveniences one meets with in beginning to use the frame. The chief of these inconveniences, and indeed the only one worth mentioning, is this—that at first the frame seems to get in one's way. One is so used to the rubber being snugly drawn back against the cheeks, that the wire which stands somewhat away from them is rather annoying. But after a very little time and practice, one fails entirely to notice this; and one's only feeling is one of satisfaction at the great comfort afforded to the patient. The slight modification in the frame that I referred to just now as having adopted, simply consists in the use of a lighter wire than that of which the depôt frames are made. I use wire about half as thick as that generally employed; I find it quite strong enough, and its lightness is a distinct advantage.

Another matter that I feel strongly upon, and about which I should like to elicit opinion, is the use—or rather, the abuse—of CLAMPS with the rubber dam. In very many cases where clamps are commonly used, ligatures would do as well or better, and at the same time be far less clumsy for the operator, and far less painful to the patient.

It is, of course, perfectly true that a well-fitting clamp may, in most cases, be applied with little or no pain; but if it has to remain in place some time, the movement of cheek and tongue, and the casual touches of mirror or instrument, tend to make the clamp settle down upon the gum in a most painful way. As a matter of practice, it may be maintained that the rubber can be kept in position without clamps on all teeth, except lower molars and second upper molars. Occasionally the first upper molar requires clamping, and very occasionally a bicuspid. By the well-known device of a bead, or a bit of amadou knotted into the silk, a ligature will often effect the same purpose as a clamp, and with very much less distress to the patient.

Into the consideration of the various means of excluding moisture other than the use of the rubber dam, I do not propose to enter, except to mention one method which I value very highly, and which is not, I think, used nearly as much as, with advantage, it might be. I allude to the combined use of CLAMP, SALIVA EJECTOR, and PAPER-FIBRE LINT. For a short operation on lower molars, such as the application of a dressing, or the insertion of an amalgam, or gold-tin filling, time is saved, and the convenience of the operator and the comfort of the patient best consulted by this way of working. The instrument used is the

so-called Stokes' clamp, having a tongue-guard and ejector-nozzle attached to it. This effectually checks the moisture on the lingual side, and keeps the tongue out of the way; whilst a properly shaped and properly folded piece of paper-fibre lint commands the flow of saliva from the parotid gland. A convenient piece of lint, in average cases, is in shape about two inches long by one broad, with one corner rounded. The round corner is placed against the lower third molar, and the square top is folded down to the extent of about half-an-inch, so as to ensure a double thickness against Steno's duct. Very neat and very effectual I find this plan to be.

The mention of cases in which the rubber dam may be dispensed with, leads me to speak of TIN AND GOLD as a filling material. Used in the form of tape or loose rope, in the proportion of two sheets of Abbey's non-cohesive gold, No. 4, to one sheet of White's tin, No. 4, this combination is a very valuable one, as I am sure many here present can testify. In many instances it is not merely a good alternative to gold, but it is much superior to the precious metal used alone. In particular, it is most useful in dealing with coronal and labial cavities in second and third molars, especially in small and medium-sized cavities, and in teeth of a low standard of strength. The rapidity with which it can be

safely worked makes it extremely useful in cavities far back in the mouth. And the fact that absolute dryness is not essential to its successful working makes it pre-eminently suitable for cases where there is a difficulty in the exclusion of moisture. And further, there seems to be no doubt that tin, and tin and gold together, do exercise a marked preservative action on teeth of loose structure or imperfect calcification.

Used in large cavities much exposed to the wear and tear of mastication, it is a good plan to face the filling with gold alone, leaving a thin marginal line of tin and gold or tin alone. This does away with the objection that in extensive coronal fillings tin and gold presents, in the course of time, an uneven surface.

I have spoken particularly of molar cavities, but in hidden approximal cavities also the combination of the two metals does excellent service; and so much do I value it, that frequently even in incisor cavities I use a thin layer of it on the palato-cervical margins of weak teeth.

Tin and gold works, of course, non-cohesively, and is quite unsuitable for use with the mallet; and this brings me to a part of my paper which must, I doubt not, provoke some antagonism, inasmuch as it deals, briefly though it may be, with the comparative merits of HAND PRESSURE and MALLET work. I may say at once that, using hand-

pressure as I do to the entire exclusion of the mallet, I cannot consider myself an absolutely impartial judge, any more than an operator who makes the mallet a *sine quâ non* can be considered an impartial judge. But this much I will venture to say; that the brilliant attractions of mallet work have tended to throw into the shade the less dazzling qualities of hand-pressure fillings.

That a fine, dense, smooth surface can be more readily obtained; that more gold can be packed into a given space, and the hardness, compactness, and specific gravity of the filling greatly increased; and that a good deal of time and strength, on the part of the dentist, may be saved by the use of the mallet, as compared with hand pressure,—all these facts must be admitted. But what I want to point out is this—that a splendid surface does not by any means imply undercuts soundly filled; that perfect cohesion and high specific gravity are quite compatible with imperfect adaptation to the walls of a cavity; and that, when time is balanced against comfort, it is not always in favour of time that the scale dips.

It will be urged, quite rightly, that a good operator will take more care over the undercuts than over the surface of his fillings, and that he will pack them perfectly, using, if necessary, in deep angular corners and places difficult of access, either a flooring of oxy-phosphate, or gold inserted

by hand pressure, or both, so producing a plug the solidity of which cannot be questioned. This may be freely granted, and yet it may remain true that it is easier to overlook and leave faulty the proper treatment of undercuts with the mallet than with hand pressure. This is more especially to be noticed in such positions as the over-hanging anterior walls of coronal cavities in molars, and those parts of incisor cavities near the cutting edge.

With regard to close adaptation of the gold to the walls, and especially the margins of the cavity treated, it will, I know, be hotly contended that it is just here that the value of the mallet so conspicuously shows itself. If it does, it is too often at the risk of cracked or bruised enamel; and even waiving this, I cannot help feeling very strongly that there is a serious danger, in the vibratory nature of the mallet's blow, of shaking the filling *en masse*, and so of obtaining a compacted homogeneous nugget of gold, at the expense of that clinging to the walls of the cavity which is so desirable, and which is so characteristic of good hand pressure work. This is a difficult point to prove, and I may possibly be mistaken, but it is the only way in which I can explain some of the failures I have seen in malleted fillings.

As to the important question of time, it is possible, of course, to say that it affects the

patient as much as it does the operator—that the former is as glad to get the work done quickly as the latter is. Other things being equal, this may be so; but I maintain that, to the vast majority of patients, the gain in time afforded by the use of the mallet is as nothing compared to the comfort of doing without it. And herein lies my chief indictment against the mallet, namely, the distress that its use occasions. Fortunately, one does meet, in practice, with a certain number of people who will bear much discomfort, and even positive pain, with stolid equanimity. But the greater part of human nature is not of this admirable sort, and we have to deal with human nature as we find it; and though many patients can be got to bear much pain by the exercise of sympathetic firmness or of stern insistence on our part, the matter resolves itself not so much into the question how much pain we can induce our patients to bear, as how much it is *necessary* for them to bear. If an operator says to me: "I do not deny, as indeed it cannot be denied, that malleting is a very distressing process, but I employ it because I am convinced that without it I should fail in my duty towards my patient," I reply: "In that case you are bound to use the mallet." On the other hand, I believe that I best serve those who come to me for treatment by avoiding its

use. And this, after all, is my main contention —not so much to denounce malleting, as to maintain that good work can be done without the mallet as well as with it. From a purely selfish point of view, I should be very sorry if first-rate mallet work were ever to cease altogether; it is so very pretty to look at; but, in sober earnest, I assert my conviction that hand pressure, with a due expenditure of time and care, and the use of finely serrated pluggers, may be relied upon, in the long run, to give quite as good results as any other method, and, in some respects, better results.

In weighing results, the all-important matter of durability stands first. Given two teeth of average structure, presenting similar cavities, and with operators of equal ability to fill them —the one using a mallet and the other hand pressure—I think that the latter may be depended on to hold its own; I go so far as to say it will—in approximal cavities, and especially in teeth of weak structure—more than hold its own. Comparative comfort during the filling process, and the natural satisfaction of the patient thereat, must certainly count among results—not only immediate, but far reaching; for I have frequently been forced to the conclusion that fear of the "hammer," as patients irreverently call it, frequently adds so much to the

dread inspired by dental operations as to prolong disastrously, in many cases, the intervals between the periodical visits that ought to be paid, with the usual deplorable consequences. Again, there is a result, affecting the operator, and indirectly his cases, which calls for a moment's notice; I mean the fact that the use of the mallet tends—certainly often, if not always—to the frequent use of cohesive gold, even under circumstances where non-cohesive is distinctly called for; and this, to say the least, is a pity, seeing what great advantages non-cohesive gold possesses in its proper place.

But after all, it remains true, to use the words of a brilliant member of the mallet school, that* "The success of an operation depends more on the skill of the operator than on the material used, or the means employed"; and I have said what I have said more to defend the method I adopt, than to attack that used by others.

One more word I may perhaps be allowed to say on this subject, and I would, if I may, address it to those young operators who have only recently come under the fascination of the mallet. To them I would say this, that whilst, with all its drawbacks, very beautiful work may be, and is, done with that instrument, and whilst I am not

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* Marshall Webb's "Operative Dentistry," p. 92.

prepared to dissuade them altogether from its use, I would, in addition to what I have already said, add this, that the difficulties of doing first-rate work with it are far greater than to the beginner they appear to be. It is so easy to make a filling perfect in appearance—so difficult to make a filling perfect in reality. A dense central mass, a splendid surface may be obtained by anyone ; but to build solidly against the walls and into the out-of-the-way corners of the cavity, and to obtain perfect margins without damaging enamel edges, requires the utmost care and circumspection, and the greatest watchfulness in testing at every step each layer of gold inserted. Whatever else may be said in favour of the mallet, it cannot be said that the operator can *feel his way* so well with it as with the hand plugger ; at least, not at first, nor for many a long day.

And here I would venture to make an earnest appeal to those just entering upon dental practice, and to those whose business it is to teach our students,—not to make time a matter of the first importance. Three things there are which go to make an ideal operator—thoroughness, gentleness, quickness—and surely one should cultivate these qualities in the order named. If gentleness of touch and manner is put first, then thoroughness must suffer ; if rapidity is put first, then one may say good-bye both to thorough work and to considerate work.

It always makes me shudder when in my hospital rounds I hear a student boast of rapid work, or even ask how rapidly such and such an operation can be performed. Such a question asked of me receives the invariable answer, "Just so long as to ensure, in the first place, absolutely sound work; and in the second place due consideration for your patient's comfort. Given sound work, given due consideration for the patient, you may then think of the pace, but not till then."

From the vexed question that I have ventured to touch upon, let me turn for a few moments to the question of CONTOUR FILLING. I am inclined to think that in this matter I shall find myself happily in agreement with most, if not all, of those who are so kindly listening to me, when I say that the longer I practise the more value do I set upon contour filling, as a means of preserving the teeth from caries; that is to say, when the filling can be so shaped as to knuckle quite closely to the neighbouring tooth or filling, so closely, that is, as to prevent the passage of food towards the interstitial gum. If this close approximation to the adjoining tooth cannot be obtained, it is almost needless to say that the contouring of the filling becomes not only useless, but generally worse than useless, inasmuch as it rather favours than prevents the lodgment of food at the gum margin.

And whilst *such* contour fillings are to be deprecated, so too, in my opinion, are those extensive edifices which, having no preservative influence, are built up solely to restore the original outline of the tooth under treatment. They are, to my mind, uncalled for, alike from a surgical, an artistic, and a useful point of view. Likewise uncalled for, I think, and undesirable from the standpoint of our patient's best welfare, are huge gold contour fillings in molars. Where filling is admissible, a carefully inserted and carefully finished amalgam serves the required purpose best in the great majority of cases; and where there is very extensive disease, both mesial and distal, gold collar crowns, duly and properly adapted, afford the most satisfactory means of restoration. In the insertion of large contour amalgams I have lately found great assistance in the use of the new screws just introduced: their application is very simple and easy, and they form a valuable addition to the ordinary Howe screw post, which is so convenient in the case of dead teeth.

Before I leave the subject of fillings proper, I should just like to urge any who have not yet tried the Maxfield disc-holder to do so without delay. It is simplicity itself, it never fails to hold the disc securely, and it never seems to wear out.

The contouring of fillings as a safeguard against decay leads one naturally to that other, and diametrically opposite, means of attaining the same end—I mean the isolation of approximal surfaces by the EXTRACTION of teeth. To some this is anathema maranatha, and we occasionally hear solemnly preached the sin of breaking the dental arch, or of interfering with articulation, and so with the functional activity of the teeth. Granted that it is an axiom of good dentistry not to extract a single tooth if by any means it can be advantageously saved, and admitting to the full that to interfere with normal articulation is not permissible except for very good cause shown; it is, I think, abundantly proved by experience that in nine cases out of ten, young mouths are vastly improved and benefited by the extraction of one tooth out of every eight, and that even in those few cases in which the articulation is somewhat disarranged by such extraction, the mal-occlusion is a lesser evil than that resulting from the retention of the full thirty-two teeth. In other words, very good cause *can* be shown in nine cases out of ten for risking any harm that may result to the articulation from the removal of four molars or bicuspids; and a tooth, however slightly decayed, or even if sound, is *not* advantageously saved, if its retention shortens the life and subsequent usefulness of the adjoining teeth.

Primarily, of course, the object of a bilateral extraction in both upper and lower jaw is to relieve more or less irregularity of position due to overcrowding, but in mouths where the teeth are of weak structure, and much decay, or the threatening of it, are already apparent by the twelfth year, it is quite unnecessary to wait for marked overcrowding as a reason for the use of the forceps. In fact, it is just in these cases—of weak teeth without any marked crowding—that the advantages of extraction are most conspicuous, so far at least as its effects on decay are concerned. For where there is no great pressure, the spaces left by the extractions do not so rapidly fill up, and the teeth anterior to the spaces, especially the bicuspids, tend to become spaced themselves. And it is these spaces, that in the case of teeth very prone to decay, are so important and useful, especially if, when they are not quite wide enough to prevent the accumulation of food, they are judiciously shaped by corundum discs.

One point with regard to overcrowding I should like to emphasise, as it is apt not infrequently to be lost sight of. Cases present themselves of patients whose age may be anything between thirteen and eighteen, or even more, and whose teeth are closely set, with, perhaps, a very slight tendency in the canines or laterals to overlap adjoining teeth, but without any noticeable appear-

ance of over-crowding, or consequent irregularity. This is prior to the eruption of the third molars. Directly these teeth begin to show themselves a marked change takes place in the arch; the canines, or laterals, or both, being forced out of place, so as to badly overlap their neighbours. Then it is one wishes that timely extraction had been performed at an earlier age, so as to prevent the tremendous forward pressure exerted by the third molars from affecting the front teeth.

I mentioned just now the valuable services rendered by COLLAR CROWNS. I will, with your permission, occupy a few more minutes in drawing your attention to two modifications of the usual form of these crowns, both of which, I think, fill a niche of their own. The first of these was introduced by Mr. Whittaker, of Manchester, and consists of a form of crown especially adapted for laterals and centrals. In trimming the root, Mr. Whittaker leaves intact the palatal enamel which, in most cases, projects considerably beyond the neck, where cementum and enamel meet. This retention of the palatal enamel necessitates such a special contouring of the palatal portion of the collar as that its gingival margin shall fit the neck of the tooth accurately, while the other margin shall give room for the projecting enamel; in other words, the gingival margin has to be less in circumference than the

other. Consequently, the collar, when fitted, can only be got into place by carrying up the palatal portion first, and then springing the labial portion over the labial margin of the root. It is claimed that this shape of collar adds greatly to the stability of the crown, inasmuch as it enables the latter absolutely to resist the great forward pressure sometimes exerted by the bite. The method of springing the collar into place precludes the use of a pin in the pulp canal; and, indeed, it is urged that this is an advantage, as the pin becomes quite unnecessary. This form of crown I have used in one or two instances lately with much satisfaction. Particularly in one case of a broken-down central, with a living, healthy pulp, did I, two days ago, find this method admirably applicable, as I was enabled to fix the crown securely without opening the pulp-chamber.

The second modification is one that I have twice found of great service. One illustrative case I will briefly describe. The root of a second upper bicuspid which it was important to crown, presented this difficulty—that its palatal margin was so much diseased as to make a firm hold for the usual collar not available. I prepared a collar in the usual way, getting as good a hold on the sound part of the root as possible. Then I inserted a Howe screw post in the palatal canal.

A diaphragm was soldered about half way up the collar, and a hole made in the diaphragm for the post to pass through; then the labial cusp was made solid and true to the bite. Thus I had what is roughly indicated on the blackboard at A; a collar with a diaphragm; a solid labial cusp; and in place of a palatal cusp an open chamber. The letter W indicates in section a wire that was soldered to the outer edge of the chamber in order to make it rounded and solid. The under surface of the diaphragm being charged with oxy-phosphate of zinc, the crown was carried home, a washer was placed over the post in the chamber, and a nut screwed down upon that, so making all secure. The chamber was filled up with phosphate, the surface of which, at an early day, is to be replaced by gold. The use of the wire round the margin of the cavity thus to be filled with gold will make a much better finish than one can get with the mere thickness of No. 4 plate as a cavity wall.

Gentlemen, I beg to thank you for the patient hearing you have given me, and I only wish that what I have ventured to lay before you were more worthy of the kind consideration you have shown.

Discussion.

Mr. Robbins said he thought it spoke well for the Society that they could have on the same evening a scientific paper such as they had had from Dr. Miller and the discussion which followed, and also a practical paper such as Mr. Matheson had read to them. It was a paper bristling with points having to do with their every-day practice. He would refer to one or two; and the first was the difference between hand pressure and malleting. He spoke as an operator of sixteen or seventeen years' standing, but he would rather speak as a patient of some considerable experience. He had in his mouth something like twenty-six fillings that were put in by one of the most thorough men he knew, and to whom he owed very much, but he could not ask honestly, and on humanitarian grounds, nineteen-twentieths of his patients to endure those beautiful little retaining points and the malleting directly upon the most tender part of the tooth, combined with the long sitting, notwithstanding the ultimate beautiful result. He thought if they could get a good durable filling, such as they knew Mr. Matheson's to be, by hand pressure, there was something to be said on that score. It was a question, after all, of thoroughness. There was one point not mentioned by Mr. Matheson which he would like to name, because he had spoken about it in another place, and it was somewhat smiled at—the question of using for the first third of the filling, when one did not wish to exaggerate contour, that most valuable material, matt gold; and where the tooth was of a very fragile nature even underlaying that with oxy-

phosphate, setting the matt gold in, like wooden blocks in a pavement. They could then with firm but gentle hand-pressure work down the surface and bring that up to within one-third of the finish. Then if they wished the edges to be absolutely right and used gold foil, the malleting would not be so very serious a matter, and they might have a cohesive filling inserted with but little discomfort to the patient. He agreed perfectly with Mr. Matheson, and everyone who knew that gentleman thoroughly would appreciate what he said, that there was as much value to the patient got out of a good honest amalgam put into a large cavity in the back of the mouth, and sometimes a little more, than in those extraordinary acrobatic performances that took so long, tiring both patient and operator; and if in the one case they had something to show, by the other method they would have something more solid and more comforting to the patient.

Mr. W. Hern said he must congratulate the reader on his very interesting paper. As had been said, it was bristling with practical points. The first point that struck him was the little device that had been brought forward of the wire for holding the rubber dam. He had seen the contrivance, but had not used it much because it got a little in the way. He thought the difficulty might be overcome by bending the wire somewhat in the shape of the lower jaw; the end would then lie back out of the way. The one point to which Mr. Matheson devoted a good deal of the paper was a defence of non-cohesive gold. There was a time when he thought that no good work could be done—at any rate, in contouring—with anything but cohesive gold, and he would go further, and say there was a time when he thought cohesive work done with hand-pressure was not at all equal to cohesive work done with the mallet. He had now come to the conclusion that very excellent work could be done with hand-pressure. In criticising the mallet the fact should be taken into consideration that it was frequently used with a blow far out of proportion to the requirements. The cohesion did not depend so much on the blow as on going accurately over the whole surface,

doing what the great master of the cohesive method used to call " bringing each piece of gold into the sphere of cohesion," that was to say, going very carefully over the whole surface rather than trusting to a heavy blow. That was one of the reasons why the mallet had been tabooed. He ventured to think that what ought to have been more criticised was the preparation of the cavity. The reader spoke of the method of malleting gold under overhanging edges, but they knew that no cohesive gold, and not even soft gold, could be condensed under over-hanging edges. His sympathies were entirely with Mr. Matheson with regard to the importance of contour. Contouring was the most important thing in their work. They told their patients that food was the cause of decay, and that no food should remain between the teeth. It came therefore to this, that if a flat stopping was put in where it ought to be contoured, the patient was sent away with a faulty operation from the very first, inasmuch as food was permitted to wedge down to the gum, to ferment and cause decay, or to interfere with the gum margin. He also agreed as to the value of collar crowns, which had a value beyond all other crowns, because they could be contoured in a way that could not be done with any other fixed crown, such as the Logan.

Mr. G. H. Badcock said the paper was full of practical suggestions, but he would confine himself to what the author said about tin and gold. He wished to endorse all that had been said on that head. He had used tin and gold in the way described for a good many years, and with more success than he had found resulting from any other filling material. If he were obliged to make his choice as to any one filling material, and to be deprived of all the rest, he should certainly choose tin and gold. He had used it chiefly in the way described, one sheet of No. 4 tin between two sheets of No. 4 gold, but lately he had been using No. 5 gold, simply with the object of improving the colour of the combination. He found in all cases that it worked very well and distinctly improved the colour of the filling. He was trying to get some No. 3 tin made to use with No. 4 gold, and so obtain the same

result with more ease to himself. The value of the filling was extremely great in interstitial cavities in the bicuspids, and even molars, where foil could be used. He had felt the unsatisfactoriness of amalgam in such cases, and foil could be used easily, fairly rapidly, and very satisfactorily in this way, more so than in any other that he knew.

Mr. Dennison Pedley said that the only thing he wished to call attention to with regard to the difference between malleting and hand pressure in gold, was that there were two very important factors to be considered—one the tooth, and the other the patient. A short time ago a young lady, aged 21, consulted his partner with regard to caries in her teeth. He found a great number of the teeth very carious. On carefully examining the mouth he came across a very beautiful gold filling. On asking her why with that good gold filling in her mouth she had allowed her teeth to remain without treatment so long, she said, "Well, my mother took me when I was 16 to one of the best dentists, and I had such a terrible time of it with the mallet that I vowed I would never have another tooth stopped." That might appear to be rather silly, but still they had to deal with facts as they were, and he always confined himself to filling teeth with hand pressure until he found out what sort of nerves his patient might have. He thought the combination of the two, filling first with hand pressure and finishing off with the mallet, was about the best method they could have, but practically they could not lay down any definite law on the subject.

Mr. Beadnell Gill said he had been for many years a considerable practiser of mallet work, and must confess his great appreciation of it. He believed that an enormous amount of pain was inflicted unnecessarily by malleting work; but he thought that those men who still advocated the use of the mallet, could continue it with a considerable amount of success and saving of time to themselves and their patients by judicious management as to the direction of their blows. For one thing, they knew the great advantage of seizing the right time for filling the teeth. In illustration of this he mentioned a patient who, through

illness, was unable to keep the original appointment, and had she come then he could have filled the tooth without a single tear. He had already filled six or eight of her teeth in exactly the same way and had no trouble whatever, but through her having to remain beyond the right time, after wedging he could not possibly, either by hand or by mallet, fill that tooth without producing the discomfort which he objected to inflict on his patients. He felt that if he had to distress his patients like that, much had been done to discount the good effect of the best work that could possibly be put in. With regard to filling material, matt gold had been mentioned, and he thought that or crystal gold was a material well worthy of investigation. Those who knew him would smile, because they knew this was an old hobby of his. He had filled with crystal gold for over twenty years, and it was still his special favourite although he had tried every other kind of gold introduced from time to time. He believed that if a man was willing to adapt himself to circumstances and according to his material, he would find that in all round filling there was nothing better than crystal gold. It could be used either cohesive or non-cohesive, either by hand pressure or by malleting. He had fillings he could look back upon, done eighteen years ago with crystal gold, put into the most frail incisors of girls from 14 to 16 years of age, entirely by hand pressure, and they were standing good to this day. It showed that an enormous deal of good work could be done on these most frail of all teeth by hand pressure. At the same time others had been done with the mallet, and he could see absolutely no difference in the ultimate result after many years. It was merely a question of time, and he believed by judicious arrangement a man might save a patient perhaps a quarter of an hour's sitting, which was a consideration, by using the mallet, and yet do no harm by causing any unnecessary distress.

Mr. Baldwin said with regard to the rubber dam holder, one advantage which had not been mentioned was that at least on one side the patient could easily breathe, and they knew that many patients could not breathe except

through the mouth. He agreed with Mr. Matheson on almost every point of his paper except that he should not like to do away with the mallet altogether. Hand pressure was perhaps the more useful of the two. but the mallet had its own special uses, particularly in finishing off the filling. When a filling was of any size it would certainly produce a better continuous surface, taking a higher finish and therefore being less visible afterwards. It also did away with the great tendency of hand pressure instruments to slip, which was a serious thing both for the operator and the patient sometimes, especially when working with a mirror. The Woodhouse plugger, for instance, was liable to slip when the operator was working with the mirror, and was very likely to injure his face. He had known an instrument stick into the forehead of the operator, very near the eye, through slipping in this way. Then, of course, the tearing of the rubber dam was also a serious question, which would be avoided altogether by malleting.

Mr. VANDERPANT asked what kind of mallet the author was in the habit of using, and whether he used the electric mallet. In his own small experience, he found very good results from the old fashioned hand mallet; it could be used with very great precision, and the force of the blow modified. No doubt that mallet had long been superseded, but there was still room left for it, and he strongly recommended members to give it a trial.

Mr. MATHESON, in reply, said with regard to the principal question that had been discussed—that of malleting and hand pressure—that as he did not use the mallet at all himself he could not be considered by any means a perfect judge of its value. He had rather wished to point out the merits, such as they were, of hand pressure rather than the demerits of malleting, and to emphasise also the difference between what had been called judicious and injudicious malleting. He had perhaps, to some extent, exaggerated the merits of hand pressure, partly because that was the only kind of work he knew personally, and partly as a sort of counterblast to the exaggerations undoubtedly made in favour of malleting. He was very much indebted to Mr.

Badcock for his suggestion as to a larger proportion of gold in making tin and gold fillings. The one great disadvantage of tin and gold fillings being their appearance, he should certainly, without delay, try the method that Mr. Badcock suggested. With regard to the wire dam holder, the movements of the wire, though troublesome at first, could be got over. He first saw it adopted by Mr. Fernald, of Cheltenham, and after using it in one or two cases he put it on one side. Some two or three years afterwards he saw a modification of it used, and after a little experience with it, he soon came to absolutely discard retractors. In the form in which he used it, it might be made to stand back against the face; it admitted of a certain amount of bending, so that, although they could never do away with the loose ends, they could get rid of them to a large extent.

The PRESIDENT having expressed the thanks of the Society to the various gentlemen who had contributed to the evening's discussion by Casual Communications and Papers, and especially to Dr. Miller and to Mr. Matheson, the Society adjourned till January 13.

Odontological Society of Great Britain.

ORDINARY MONTHLY MEETING.

January 13, 1896.

MR. DAVID HEPBURN, L.D.S.ENG.

PRESIDENT, IN THE CHAIR.

THE minutes of the previous meeting were read and confirmed.

The following gentleman was elected a non-resident member of the Society:—HENRY BAMBRIDGE, L.D.S.I., 27, King Street, Great Yarmouth.

The following gentleman was proposed as a non-resident member of the Society:—HAROLD DEWE MATTHEWS, L.D.S.Eng., Grove Field Villa, Cheltenham.

The CURATOR stated that he had received from Mr. W. B. Burrows four old bone plates with natural teeth mounted upon them, and also a similar lower plate presented by Mr. Murray Davis. The Society was greatly indebted to these gentlemen for their donations, as such specimens became rarer every year.

Mr. Aubrey Farebrother had been kind enough to send a vulcanite plate of very primitive workmanship, and he had also sent four upper incisors from the mouth of a patient of his. Three of these teeth were very deeply grooved at the necks on the labial aspect, but the right central was only slightly eroded.

It was commonly stated that erosion did not occur in dead teeth, and it certainly looked as though there had been some special retarding influence at work to protect this tooth, while those on either side, and in immediate contact with it, were so deeply affected.

To Mr. Morton Smale they were again indebted for two most interesting specimens of comparative dental pathology. The first was the skull of a black antelope (*Cephalophus niger*), the upper anterior grinding teeth of which were much worn, while a large inflammatory cavity surrounded the roots of the left upper first molar.

Mr. Smale's second specimen was the skull of a Panolia deer (*Cervus eldii*). The alveolar margins were extensively absorbed, forming cup-shaped cavities around the roots of the molars. The cavities during life were probably occupied by thickened vascular periosteum, such as was met with in cases of pyorrhœa alveolaris.

The President said the thanks of the Society were due to the donors for these very interesting specimens.

Mr. Gartley presented a model showing supernumerary teeth.

The Librarian reported that he had received the usual periodicals.

Mr. Mummery showed specimens of ivory, which were, he said, of considerable interest. One was part of an elephant's tusk, showing a very large pulp-stone occupying the entire width of the pulp cavity. It was possible that some foreign body had formed the nucleus of the pulp-stone, but he had not yet been able to have it properly sawn through for inspection. He also showed a very interesting specimen of ivory given him by Professor Miller, of Berlin. It was a section of a tusk taken from an Indian elephant. The animal had been moved from one part of the country to another, with a consequent change of food. A ring of green stain would be seen in the section which was concentric with the pulp cavity, and was evidently due to some vegetable substance in the food, which stained the ivory in the same manner as madder stained growing bone.

The width of the ring indicated about a year's growth of the tusk. The animal had probably been then removed to some other district, where this colouring matter, whatever it might be, was not contained in the food, and the ivory subsequently formed was normal in colour.

The Foreign Secretary then read a communication forwarded by Dr. Dentz, of Utrecht, entitled "An Anomaly of the first upper Temporary Incisor, and its Morphological Significance":—

Deformities of any part of the body give rise to the questions: (1) How have these deformities originated? and (2) Are we really entitled to call them deformities?

It must first be settled whether, in every concrete case, the word *deformity* is a well-chosen term, and whether the deviation from the normal form has no other significance, either of *atavism* or of *reduction*.

In which cases are we entitled to speak of *atavism*, when anomalies of form come under observation; in which cases only of deformities depending upon disturbing influences—influences which we may accept hypothetically, but the accuracy of which is seldom demonstrated?

The answer to this question is, I think, that if the anomaly of any organ is repeatedly observed, if the anomalies show a certain regularity, we have no longer any right to look for external disturbing influences, but in these cases we must assign another meaning to the anomaly.

I have sometimes observed an anomaly of this kind in $I^{\frac{1}{1}}$ D (the first deciduous upper incisor), an anomaly which struck me by the regularity of its appearance, and which, at first, I was at a loss to interpret.

The anomaly under consideration is this: $I^{\frac{1}{1}}$ (deciduous) is very broad in its labial surface, and shows a more or less pronounced indication of being split along its longitudinal axis. On its lingual surface, where the splitting is also discernible, we notice a pointed prominence covered with enamel, a kind of enamel growth very much resembling a small tooth, or rather a reduced form of $I^{\frac{2}{2}}$, the "Zapfenzähne" of the German authors.

If this anomaly was only met with a single time it might

be attributed to accidental circumstances, as we so often see in nature, and especially with the teeth. But as the cases are, comparatively speaking, frequent (I have been able to collect six cases for the collection of the University Dental Institute at Utrecht), the case is quite different, and the question arises, how we have to explain the fact?

A satisfactory explanation can only be given, I think, by accepting the views of Professor Rosenberg, of Utrecht, who in the beginning of this year published his researches in the *Morphologisches Jahrbuch*, xxii. *Bd.*, *3 Heft*, under the title: "Ueber Umformungen an den Incisiven der Zweiten Zahngeneration des Menschen" (Leipzig, Wilhelm Engelmann).

Part of his work is devoted to the question if the typical, normal or general formula—

$$I\,\tfrac{3}{3}\ C\,\tfrac{1}{1}\ P\,\tfrac{4}{4}\ M\,\tfrac{3}{3}$$

for the mammalia, as accepted by many authors, is correct with regard to the incisors, to which he has limited his investigations.

One may differ in opinion about the value of the formula. It is certain, says Rosenberg, that the greater number of teeth of a special kind, which serve as comparison with a special row of teeth, must be accepted as the expression of a primitive state. The changes which the dental system of the various classes of the vertebrates have undergone, all show the very important part that is played by reduction, although it is, of course, not the only modifying process. On the other hand, no observations in the phylogenetical development of any higher differentiated forms are available which, even in some measure, would justify us to accept the originating of new forms of teeth.

At first sight, the formula $I\underline{3}$, as the primitive form for the genus "Man," seems acceptable. Many observations tend to corroborate this view. Rosenberg cites the cases of Von Metnitz in his Atlas (Heider and Wedl's, newly edited in 1893, Leipzig); of Albrecht, who observed two cases; of Turner, who mentions one; and of Busch, who saw two cases of three incisors (superior) at each side. Then cases in which three superior incisors existed, only

unilateral: Busch met with this condition six times, Virchow twice.

Rosenberg agrees with all who consider these cases as atavistic. This is the only possible explanation, he thinks. But the claims of an explanation are not satisfied with this decision. It still has to be shown which of the three incisors has been reduced during the phylogenetical changes.

Upon this question, Rosenberg tells us that *three* views have been propounded:—

(1) By Hensel, who concluded that the most laterally situated incisor ($I^{\frac{3}{-}}$) had disappeared, he comparing the conditions with those of some mammalia.

(2) By Baume and H. H. Edwards, who are of opinion that the *central* incisors have disappeared, the two of which we are in possession being $I^{\frac{2}{-}}$ and $I^{\frac{3}{-}}$.

(3) By Albrecht (in his work entitled "Sur les 4 os intermaxillaires, le bec-de-lièvre et la valeur morphologique des dents incisives superieures de l'homme," Bruxelles, 1883, pages 18 and 19), Turner, and A. Wilson, who think that the $I^{\frac{2}{-}}$ has been reduced, and those left are $I^{\frac{1}{-}}$ and $I^{\frac{3}{-}}$.

Professor Rosenberg remarks that all these authors advance evidence for their own opinion, but do not mention or insufficiently speak of, the other possibilities. It has now to be considered which of the opinions propounded is the most probable one, or if perhaps two or all three of the modes named above, have taken an active part in the reduction.

For simplicity's sake, Rosenberg uses the following terminology: he maintains the terms $I^{\frac{1}{-}}$ and $I^{\frac{2}{-}}$ for our two normal incisors. These, then, are homologous with the same organs which are also met with in cases of atavism. But those teeth, which in these cases have to be considered as the atavistic teeth, and which generally are called supernumerary teeth, he designates by the names of $I^{\frac{\alpha}{-}}$, if they are seen at the mesial side of $I^{\frac{1}{-}}$; $I^{\frac{\beta}{-}}$ if present between $I^{\frac{1}{-}}$ and $I^{\frac{2}{-}}$; and I^{γ} if between $I^{\frac{2}{-}}$ and C.

Now Rosenberg finds that we are obliged to admit of an $I^{\frac{\alpha}{-}}$, $I^{\frac{\beta}{-}}$, and I^{γ} having previously existed. We would be

going too minutely into details to quote the arguments which he alleges to prove his opinion. Those interested in the question will prefer reading the original. It may suffice to state that Rosenberg has consulted vast collections of casts, skulls, and as much of literature on the subject as perhaps exists, and that he, contrary to the opinion of Virchow and Busch, considers every supernumerary tooth covered with enamel as an atavistic (*i.e.*, reduced) one.

So it appears that, in the formula, $I\frac{3}{-}$ is not correct. Rosenberg does not set great value on a formula, but, if a formula must be, the 3 has to be changed into a 5. Of the five primitive incisors, then, the first, third, and fifth have disappeared, and the two incisors left are the *second* and the *fourth*.

Now, if Rosenberg's deductions are correct—and I do not think they can be contradicted on any plausible grounds—the anomalous temporary incisors I have described have, I think, to be considered as $I\frac{\alpha}{-}$, $I\frac{1}{-}$, and $I\frac{\beta}{-}$ coalesced, or a coalescence of $I\frac{1}{-}$, $I\frac{\beta}{-}$, and $I\frac{2}{-}$, or even of $I\frac{\beta}{-}$, $I\frac{2}{-}$ and $I\frac{\gamma}{-}$, as probably is the case in fig. 5—a new evidence of the accuracy of Rosenberg's hypothesis, that $I\frac{3}{-}$ in the formula is a mistake.

It is rather astonishing that so little attention has been paid to the temporary dentition of "man" in questions like those now under consideration, although it cannot be denied that the chances of observation are somewhat restricted, these teeth being shed at such an early stage of life. It certainly cannot be because we have no right to attribute the same value to the temporary set, in the history of evolution, as to the permanent teeth. Rosenberg also states, in his paper, that with the mammalia the number of temporary and permanent incisors of the same form are generally similar.

The explanation I have here attempted to give is further corroborated by the fact that a coalescence of *three distinct* teeth, taking the place of a first temporary incisor, has several times come under observation. So, in the collection of our Museum, as illustrated in the accompanying figures, we see in fig. 8 three teeth coalesced *next* to each

other, and in fig. 7 a coalescence of three teeth, but I^{α}_{-} placed labially.

It still remains to be explained how it is that the three teeth should coalesce. Anyhow, this fact will less surprise anyone who has had any experience of dental phenomena with children, as double teeth—*i.e.*, two teeth coalesced—may be met with repeatedly. All such cases have to be explained as a coalescence of I^{α}_{-} with I^{1}_{-}, or of I^{1}_{-} with I^{β}_{-}, or even of I^{2}_{-} with I^{γ}_{-} (all deciduous); and it will be difficult, I think, to deny the plausibility of this suggestion. Now if two teeth can coalesce, the coalescence of three must equally be possible, and this especially as the coalescence is principally limited to the fangs of the tooth, admitting one single papilla, but still divided enamel organs.

Mr. J. F. Colyer said he had a patient in attendance, her case being interesting as an example of very rapid decay in a comparatively young child. She was about eight years old when she first came under his observation, and at that time the upper central incisors were very badly decayed, only about one-third of the crowns of the teeth remaining. The temporary and first permanent molars were also very carious, being practically level with the gum. The four lower incisors were carious at a place about half-way up. The decay was of a very soft character, and the teeth seemed somewhat hopeless to do anything with in the way of filling. He mentioned the case simply to state the method of treatment that was adopted, and which seemed to have been successful. Once a week for the first month the teeth were given a thoroughly good coating of nitrate of silver, whilst at the same time he suggested to the mother that twice a day the teeth should be dried, and then spirits of wine applied to the surface, keeping the mouth open for two or three minutes if possible, in order that the spirit might evaporate, and by that means harden the dentine. He saw the child once every two months, and applied a fresh coating of nitrate of silver. The result had been very satisfactory. The teeth under the nitrate of silver had certainly hardened up very much, and there was an arrest of the decay. The

DESCRIPTION OF THE FIGURES.

Fig. 1 represents the plaster cast of the upper teeth of a boy 5½ years old, *a* being the labial surface and *b* the lingual one. All temporary teeth are present. $I^{1.s.d}$ has about double the width of its correspondent $I^{1.d}$, and shows an indication of a split on its labial surface, running over the lingual one. At its lingual surface may be seen, arising from the smaller left part of the tooth, a prominence closely resembling a reduced I^{2}.

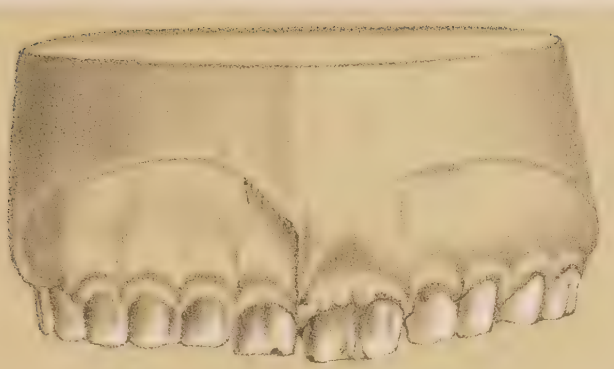
Figs. 2 *and* 3 are the first temporary incisors, right and left, of a boy aged 5 years. In both figures *a* show the labial, *b* the lingual, *c* the mesial, and *d* the distal surfaces. In *fig.* 2 the length of the affixed growth nearly reaches the cutting edge of the incisor, whereas in *fig.* 3 (the left tooth) it is about two millimetres shorter.

Fig. 4 is the first left temporary incisor of a child 7 years old, showing a deep decay at its mesio-lingual surface and a partly absorbed fang; *a* is the labial aspect, where a longitudinal groove is distinctly seen, running over into an elevated border on the lingual surface and there meeting the coalesced tooth, the dimensions of which can be better appreciated in *c*, this representing the distal surface.

In *fig.* 5, the origin of this tooth being unknown, *a* is the labial, *b* the lingual, and *c* the distal surface. The tooth has all appearances of being an upper second temporary right incisor.

Fig. 6 shows a second upper right temporary incisor; *a* is the labial, *b* the lingual surface. The cutting edge of the enormously developed affixed tooth growth on the lingual surface reaches the cutting edge of the original tooth not (discernible in the drawing). The labial surface, *a*, is not one plane, but in the line of splitting forms an obtuse angle, dividing this surface into symmetrical halves.

Figs. 7 *and* 8 shows coalescences of three teeth. In *fig.* 7 the crowns are partly lost by decay; *a* is the labial, *b* the lingual surface. In *fig.* 8, *a* is the labial, and *b* the lingual surface. The fang is partly resorbed



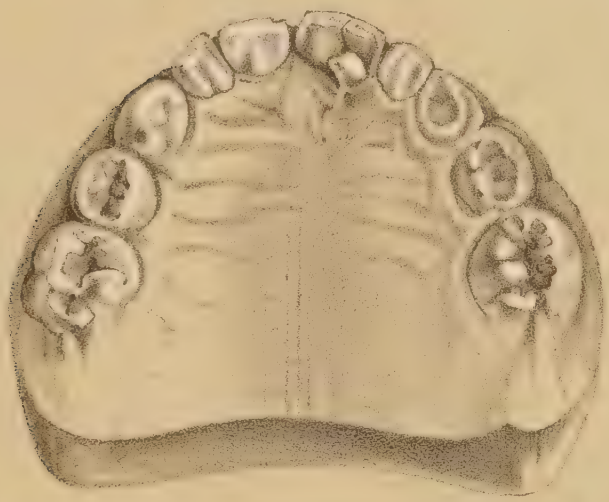


Fig. 1.

Fig. 2.

Fig. 3.

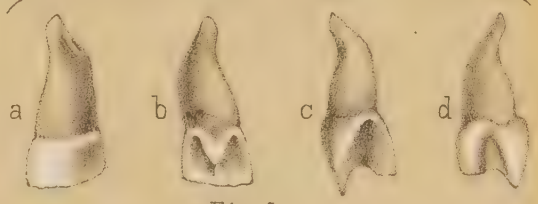


Fig. 4

Fig. 5.

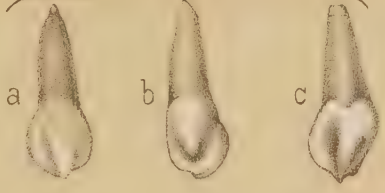


Fig. 6

Fig. 7.

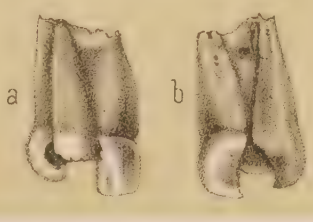


Fig. 8.

J.W. de Groot ad. nat. del. A.J. J Wendel lith P.W.M. Trap impr.

treatment seemed to have had this effect, that it had given the child something to get along with until the remaining permanent teeth erupted. He was quite aware that nitrate of silver made the teeth horribly black, but at the same time it was better to give a child some horribly black things to eat with than nothing at all.

Mr. VANDERPANT asked Mr. Colyer whether he could in any way account for the rapid caries. He had himself met with similar cases, and had found constitutional treatment beneficial.

Mr. BEADNELL GILL said Mr. Colyer had in this instance adopted treatment which he had used for twenty years, and which he believed was very generally resorted to. He doubted whether the use of spirits of wine was of any service as an additional application. Nitrate of silver, both in temporary and permanent teeth, when judiciously applied would no doubt, if persevered with, give very good results in cases where nothing else was of any avail. Of course he recognised the drawback of discolouration, but when they remembered that it was applicable specially to teeth which were habitually looked upon as hopeless with reference to any other form of treatment, he thought they might safely adopt a remedy which, although it might discolour, saved their patients the annoyance of being without teeth. He would ask if Mr. Colyer had used it in permanent teeth to any extent, and over what period he had had the opportunity of applying it.

Mr. F. J. BENNETT suggested that as the child was young, and some of the teeth appeared to be temporary, when the teeth were 'shed Mr. Colyer should save them and make sections, because when nitrate of silver had been applied for a known period, and the previous condition of the teeth was also known, it would be very valuable to see the exact effect upon the dentine under such conditions. It was easy to talk after the event, but it would have been perhaps well to have withheld the nitrate of silver from one or two of the teeth as a sort of control experiment, to observe how far the teeth would have corrected themselves without that

application; at any rate the nitrate of silver appeared to have been valuable in this case, and as Mr. Beadnell Gill had said, it was not really a new application. Nitrate of silver had been largely applied, and was mentioned in the early editions of Tomes' Dental Surgery. He had himself used it, when pivoting teeth, to coat the surface of the roots. The value of nitrate of silver was well known, but if Mr. Colyer would save some of the temporary teeth, and either make sections, or allow others to do so, he would be conferring a benefit upon their science.

Mr. J. F. Colyer said he had no wish to claim that the use of nitrate of silver was anything new, but he thought that every now and then even a well-worn topic bore reviving. He could not account for the extensive decay in the teeth of this patient beyond the fact that the first permanent molars and the upper incisors presented the well-known honeycomb condition, which naturally predisposed them to decay. In addition, the child was of a distinctly strumous type. The way in which he applied nitrate of silver was that which he had learned as a student from Mr. Storer Bennett, by melting it on a piece of wire. That was certainly the best way, because it could be taken to any part that was desired, and there was no possibility of its slipping and passing down the throat. He could not altogether agree with Mr. Beadnell Gill that spirits of wine was not useful. He did not say it was very useful, but he thought there was a certain amount of utility in it, because in cases in which they had only used spirits of wine, or recommended patients to do so, they had decidedly seen a hardening of the teeth to result. Besides, he was rather inclined to advise patients to use spirits of wine, because to a certain extent it made them look after the teeth. He had constantly used nitrate of silver ever since he had been in practice, and always found the most satisfactory results. In erosion cavities, more especially in that extensive soft decay that was produced in teeth coming in contact with artificial plates, there was nothing like nitrate of silver. With regard to Mr. F. J. Bennett's request, he should be only too pleased to give him one or two of the teeth when they were extracted.

The Nature of Anæsthesia : An Appended Note.

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Introductory.

To understand the true name of anæsthesia has proved a difficult problem to many. To explain it is no mere academic exercise, for given such an explanation, it must influence us alike in the methods we adopt in handling the various anæsthetics and the means we adopt to prevent inherent dangers or to avert accidental perils. For example, in days when nitrous oxide was deemed to be an asphyxiant it was the practice to give it rigidly excluding all air. Now we recognise it has a true anæsthetic action, and so give it, as we exhibit other general anæsthetics, with air or oxygen to avoid the occurrence of asphyxial symptoms as unnecessary as they are undesirable. Nor should we be justified in employing substances as powerful as are anæsthetics, unless we could accurately appreciate their physiological behaviour. It is to inquire what

we know about anæsthesia that this note is written

Paths of Anæsthesia.—(*a*) *Nerve endings;* (*b*) *sensory nerves;* (*c*) *ganglionic centres;* (*d*) *perceptive mechanism.*

Anæsthesia occurs under various conditions. All are familiar with the disorders of sensation which occur in various forms of nervous disease, and give rise to hyperæsthesia on the one hand, and anæsthesia upon the other. (*a*) Variations in the inter relations of the end-organs of the skin or mucous membrane; (*b*) of the sensory nerve, or nerve of conveyance; (*c*) of the ganglionic nerve centres which translate the sensory stimulus into a feeling; and (*d*) the consciousness which perceives the feeling as pain or pleasure, may under morbid conditions of the organism give rise to true anæsthesia. Artificially we are able to bring about the same state of things producing a transient anæsthesia. Thus, by the use of cocaine we act upon the nerve ends in skin and mucous membranes, and prevent conveyance of sensory stimuli passing along the nerves. In the same manner carbolic acid or chloroform when applied to mucous membrane or even skin, will, by coagulating the albuminous materials with which they are brought in contact, cause anæsthesia. General anæsthetics even in a very early stage will act upon

(*c*) the ganglionic nerve tissues and prevent painful sensations being recognised. A few inspirations of ether or chloroform will without paralysing motion or dulling the conductivity of the nerves, remove sense of pain even though the patient may struggle, fight, or express in no measured terms, his views on what is passing through his mind. He is in the land of dreams, and his talk and his action have relation with phantom forms and illusory communications peopling that teeming waste. The curtain has dropped betwixt him and earth. In hypnotism we possess an example of a state in which pain is felt, but perceived as pleasure. It is, after all, life is not; only what it seems. The curious in such matters will find from Moll's book many examples of unquestionable instances of absolute anæsthesia, although there was every reason to believe that both the end organs in the skin, the sensory tracts and the ganglionic nerve tissue were intact and capable of producing and conveying sense stimuli; nevertheless the perception arrived at was not that of pain. The perceptive mechanism was blocked. In the days of Moore, anæsthesia was attempted by compression of the nerve trunks, and nerve sensations were in this way blocked at the point of pressure. Thus every link in the chain between skin which initiates

the sense stimulus and the nerve centre which initiates the perception of pain, has been tested in the endeavour to achieve surgical anæsthesia.

Peripheral Sense Organ Anæsthesia.—Local anæsthesia, the blocking of the sense stimulus at the skin or mucous membrane is, of course, of little value for any save the most trivial operations. The agents employed and the elaborate plans suggested to produce it have not proved themselves safe or sufficient. Bichât, whose ever delightful book on "Life and Death" deserves more study than it gets now-a-days, taught the duality of life, a life of mere functional existence, and one of relativity. In anæsthesia produced by agents such as nitrous oxide, ether, chloroform, the life of relativity falls into abeyance, while the functional life or existence persists. But just as it is found impossible to limit the activity of a local anæsthetic to a regional area, so is it impossible to draw a hard and fast line between the influence of a general anæsthetic upon the cerebral centres and its overflow to the vital centres.

Aim of Anæsthesia.—The problem before us is to discover how best to produce anæsthesia without allowing the ordinary processes of life to be trenched upon. We have advanced some distance along the road leading to this discovery,

but we still have very much to learn, and what is more, very much more to unlearn. Whatever personal satisfaction may be the result of a frame of mind which leads its owner to believe he knows all there is to be known about anæsthetics and anæsthesia, it is one which, sooner or later, will not be shared by the friends of some of his patients.

Study of the Action of Anæsthetics.[1]—In the course of a very able paper on anæsthesia Lauder Brunton suggests alcohol as one of the best substances to study to arrive at an idea of the way in which the general anæsthetics act. He adds that carbonic anhydride is the most widely distributed body having claims to the title of anæsthetic.

Definition of Anæsthesia.—It may be useful in this place to ask what definition of anæsthetic is to be adopted. Of course I use the word in its colloquial acceptation, the one first suggested by Dr. Oliver Wendell Holmes. It seems to be now generally admitted that although many things may produce loss of sensation through abeyance of the faculty whereby we feel pain, yet none should be regarded as anæsthetics unless they exert some definite influence upon the tissues of the body rendering them indifferent

[1] *Lancet*, 1895, vol. i., pp. 49, 80 and 143.

to pain and that quite irrespective of their preventing due access to the tissues of some vital constituent. An ox pole-axed is rendered anæsthetic; a man poisoned by a charcoal stove grows anæsthetic after inhaling the fumes of carbonic oxide gas until he is practically at the verge of death; an indifferent gas such as nitrogen, can by excluding oxygen, produce asphyxia, in the advanced stage of which, perception to pain grows deadened or lost. In these cases the stunning, the carbonic oxide poisoning, the oxygen starvation due to the indifferent gas, act by virtue of interference with necessary vital processes but possess in themselves no anæsthetic properties, and are not anæsthetic. It is true that carbonic anhydride has been employed both as a general and a local anæsthetic, nitrogen has also had its vogue; but as yet pole-axing has met with but scant favour save for the lower animals.

True and false Anæsthesia.—Brown Séquard[1] has pointed out that when carbonic anhydride chloroform and other vapours are allowed to impinge upon the mucous membrane of the larynx, trachea, or even upon certain skin areas, while they are prevented from entering the lungs, they produce unconsciousness of pain although

[1] Compt. rendus, June, 1885.

PHOTO. 1.—Transparent zone extending quite to the pulp cavity (at *a*).

PHOTO. 2.—Transparency where the enamel of the cusps has been worn down and no caries is present. On the right a transparent cone resulting from a defect in the enamel, caries from the centre of the grinding surface encroaching on the transparent zone, yet the latter has to some extent retained its integrity.

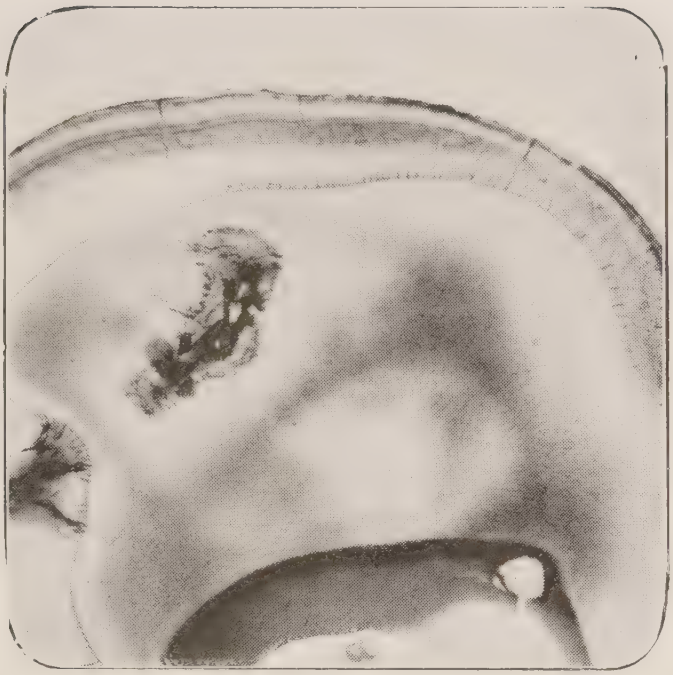

PHOTO. 3. (Slide 1.) —Decalcification of the dentine in caries advancing in a regular line (at *a*).

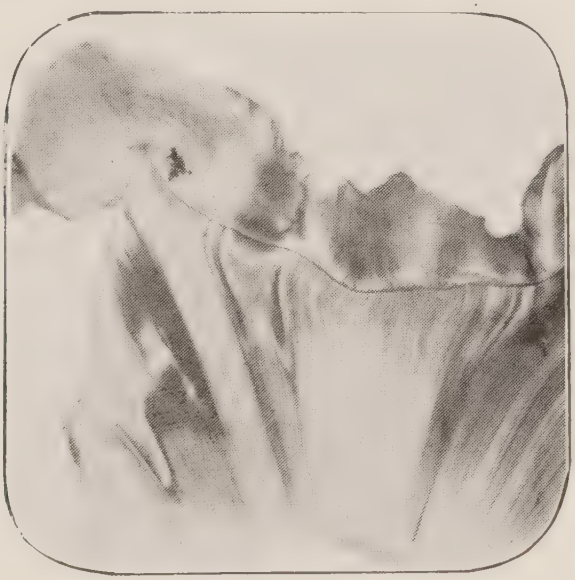

PHOTO. 4. (Slide 5.)—Transparent zone with and without caries. Transparent band extending to the pulp cavity.

PHOTO. 5. (Slide 16.)—Caries—showing transparent and opaque zones.

PHOTO. 6. (Slide 12.)—Transparency of the dentine due to cracks in the enamel.

the animal is awake and alert. Brown Séquard's theory that stimulation of the area supplied by the superior laryngeal branch of the vagus produced a sort of reflex inhibition of the brain's power of perception does not concern us at present. Carbonic anhydride has been also used as a general anæsthetic. Ozanam[1] employed a mixture of 75 carbonic anhydride to 25 of air. He rendered a young man unconscious while an abscess was opened. It has also been suggested that ether is rendered more effectual by combining its use with that of carbonic anhydride and even nitrous oxide has been used in combination with the expired air of patients, thus producing a mixed anæsthesia due to these two agents. Waller[2] has further shown that carbonic anhydride produced a brief abolition or diminution followed by prolonged augmentation of electrical excitability in the isolated nerve of frogs. This, however, is influenced by the amount of carbonic anhydride used. Expired air produces augmentation of excitability, while a large quantity of carbonic anhydride gives the result stated above, viz., primary abolition and secondary augmentation.

[1] Lyman's "Artificial Anæsthesia," p. 327.

[2] Proceedings of Physiological Society, November, 1895, published in *Journal of Physiology*, vol. xviii. "Action of Anæsthetics on Isolated Nerve."

The use of carbonic anhydride as a local anæsthetic, takes us back to the days of Pliny. But experiments have been undertaken which prove that carbonic anhydride possesses the power of producing unconsciousness only so long as the oxygen tension in the blood remains below a certain level. Gréhaut[1] employed mixtures of common air and carbonic anhydride, and found that when the animals experimented upon were completely narcotised, the gas of the blood contained 95·4 per cent. of carbonic anhydride as against the normal 34·3 per cent. (Pflüger)[2]. Gréhaut's results had been obtained by Lallemand and Perrin as early as in 1860 ("Rôle de l'alcool et des anæsthetiques dans l'organisme," p. 405). This state of unconsciousness, however, is not one of anæsthesia and is only obtained at the expense of grave peril to the individual. The bodies commonly employed as anæsthetics—nitrous oxide, ether, chloroform—must then, differ in their action from carbonic anhydride. That this is so our present knowledge permits us to say, but compels us to admit that so far as many of our methods are concerned, anæsthesia is as Dastre[3] has said, the first step

[1] Compt. rendus Soc. Biolog., 1887.

[2] Archiv. i., 285.

[3] "Les Anesthetiques Physiologie et Applications Chirurgicales," p. 34.

in a general poisoning of the organism. It is the realisation of the truth of this dictum which compels us at once to recognise the necessity of understanding the precise range of safety limiting artificial toxæmia, and to appreciate the responsibility falling upon those who undertake the control of producing and limiting it.

Theories of Anæsthesia.—In the early days of chloroform two very careful observers, Flourens[1] and Longet[2] were led by their researches to advance a reasonable enough theory. They asserted that the anæsthetics possessed a selective action upon the nervous tissues. Thus, if an anæsthetic was taken, it at once found its way to the nerve cells and produced unconsciousness. Other observers have believed that because *post-mortem* examination of the tissues of those dead after taking anæsthetics revealed the fact that the nerve tissues contained a somewhat larger proportion of the anæsthetic employed than other tissues, therefore this selective power was a reality. We now know the theory to be false and the reasoning fallacious, as the nervous tissues do not actually take up more of the anæsthetic, but retain more of it.

Mode of Action of Anæsthetics.—It then becomes

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[1] "Compt. rendus de l'Academie des Scién.," vol. xxiv., 1847.

[2] *Archiv. Général de Med.*, 1847.

a matter of very serious moment to ascertain in what way the anæsthetic enters the organism, what paths it takes, and by what means it is thrown off. Knowledge upon these points will enable us to ascertain how far anæsthesia trenches upon the vital processes of the organism. The lungs, the heart, and the brain have been called the tripod of life. Death, we know, must occur when the lungs or the heart cease to perform their function, but of the cerebro-spinal axis only the lower ganglionic centres are, even in mammals, essential to the existence of the animal. Hughlings Jackson[1] in his lectures on the Evolution and Dissolution of the Nervous System, after pointing out that the evolution of the nervous centres is the "putting together of the nervous system," and involves a correlation of the most automatic with the most voluntary—the automatic being through the necessity of the existence of the creature the most stable, and hence most highly organised, the most voluntary being open to constant change to meet environing necessities, and hence most unstable and less organised—goes on to show how dissolution is the reverse of this evolution, is, in

[1] Croonian Lectures, 1884, in *Lancet*, March 29, p. 556; see also Lauder Brunton, who quotes Dr. Jackson, and applies his reasoning to the question of anæsthesia (*Lancet*, July, 1895, p. 84).

point of fact, unpicking the lock of life. He adds: "In uniform dissolution the whole nervous system is under the same conditions or evil influence—the evolution of the whole nervous system is comparatively evenly reversed. In these cases the whole nervous system is 'reduced,' but the different centres are not equally affected.

"An injurious agency, say alcohol, taken into the system flows to all parts of it, but the highest centres being the least organised, give out first and most; the middle centres being more organised, resist longer, and the lowest centres being most organised, resist longest. Did not the lowest centres for respiration and circulation resist more than the highest do, death by alcohol would be a very common thing." If we replace the word alcohol by alcoholic anæsthetic in Dr. Jackson's remarks, we arrive at the pith of our subject.

It is, then, the sum and aim of the scientific use of anæsthetics to act upon the higher and more unstable centres of the nervous system without affecting the lower or automatic centres. But the problem cannot be narrowed down to this easily appreciated theorem. The inter-relations of the higher with the lower centres, in highly differentiated animals, are many and intimate. Dangers appear in every zone of narcosis, lest

impulses become initiated which involve the stable centres through the unstable ones.

Under normal conditions the purely vital functions of life are controlled by the lower centres, and indeed, in more humble animals, are incapable of being influenced by higher centres. In man the cerebro-spinal axis can, and does, influence the processes of life in obedience to impulses from without which require some modification of the routine of life. The diver, for example, can control the automatism of his breathing; while under the influence of pain, of shock, or of subjective fear of pain, the heart's action may be inhibited. Such interference, however, is seldom excited without voluntary connivance. The simple reflexes of life are controlled when the higher centres are working in health. As soon, however, as any disturbance of these centres occurs through it may be an "injurious agent," as Dr. Jackson calls it, there is a danger and a very real danger lest simple stimuli from without cause the most widespread reflex actions. Even those protective of the vital processes become, when unrestrained by limiting nervous control, inco-ordinated and make for the destruction of those very processes of life which it is their function to preserve. And further, the due performance of the vital processes depends upon not only nerve impulses and viscera and muscles. It

requires that these shall be in such a condition of vitality that they can perform their physiological duties. It pre-supposes also that these shall be able to meet unusual calls made upon them; if for example, the "injurious agent" at work, be an anæsthetic which produces a sudden fall of blood pressure for safety, the controlling centres of the organism must be equal to some re-adjustment by which this vascular depression may be counter-balanced. It also necessitates that throughout the whole time of the action of the injurious agent the tissues of the body shall receive their due quota of nourishment. This last essential implies that the blood stream shall be maintained pure in sufficient circulation, and capable of removing the products of tissue metabolism. A circulation capable of at once feeding and depurating tissues can only be one which passes through the lungs, and there becomes subject to those gaseous exchanges which occur in physiological life. Nor is the problem as yet clearly before us. Elimination of the injurious agent is at least as essential as the due control of those safeguarding vital processes against which it militates. Take chloroform, for example. In persons whose chests are, through pulmonary emphysema, in a state of constant inspiration, the expiratory efforts are so ineffectual that the heavy vapour readily drops into the ever patent

air cells, and there accumulates, until it reaches a tension which interferes with and threatens the mechanism of life. In the same way heart failure may occur in spite of a normally acting system of safeguards in the nervous system. If in response to demands made upon the heart by impulses from the nerve centres, that organ through disease is unable to execute the work required of it, fatal syncope arises.

All anæsthetics in common use enter the blood stream through the lungs. The inhaled vapour in passing over the pulmonary mucous membrane produces changes in its epithelium which according to McKendrick Newman and Coats[1] is inflammatory in character, "The capillaries are contracted, their walls become less distinct, and the blood corpuscles in them become partially dissolved." These changes are, however, rendered less and less as the vapour employed is diluted more and more. It is probable that these effects are the result of an irritant as far as the epithelial cells and capillaries are concerned. The influence upon the corpuscles is, however, different, and, furthermore, varies in the case of different anæsthetics. In every case blood removed from the body and shaken with

[1] Glasgow Commission on Chloroform, quoted by Lauder Brunton, *op. cit.*, p. 85.

an anæsthetic shows destruction of the corpuscles, and reduction with pouring out of the hæmoglobin. It would appear also that a similar if a less marked phenomenon occurs in the body. Da Costa[1] has demonstrated that "Etherisation produces a marked diminution in the hæmoglobin of the blood." He finds also that with destruction of the red discs, a change in the character of the leucocytes becomes apparent. I am at present investigating this point, and have up to the present time found that a decided diminution in the corpuscles takes place under nitrous oxide, ether and chloroform. It is, however, not improbable that factors other than the anæsthetics may be found at work in bringing about the result.

The combination or association between the gaseous anæsthetics or vapours and the constituents of the blood must be a loose one, since in their presence oxygen is displaced. Were they to form combinations as stable as that which carbonic oxide establishes, not only would the anæsthetic displace but would render it impossible for the reformation of oxy-hæmoglobin. Hence death must result. Whether or not, in certain conditions, the corpuscles have less power

[1] "The Blood Alterations of Ether Anæsthesia," by Dr. J. C. Da Costa, *Medical News*, March 2, 1895.

of again taking oxygen after prolonged anæsthetisation it is impossible to say. It seems that probably such is the case. Deoxydation of the tissues[1] at one time was thought to be the explanation of anæsthesia; we now recognise this is not so, for among other reasons we can produce profound anæsthesia with hyper-oxygenation, and many deoxidating bodies have no anæsthetic properties.

When it is remembered that the tissues are dependent upon the red corpuscles for their nutrition this question of their destruction by anæsthetics assumes a position of great importance. Hayem[2] has demonstrated that in anæmic and diseased states of the kidneys and liver the corpuscles are manifestly deficient in quantity and quality, and Haldane, working with Lorraine Smith,[3] has asserted that the corpuscles possess a different oxygen capacity. If, for example, one layer of these bodies can acquire and convey a certain amount of oxygen to the tissues, another will carry more or less as the case may be. We have yet to learn how far pathological conditions affect this oxygen capacity of blood corpuscles. It is not impos-

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[1] "Practice of Artificial Anæsthesia," *Brit. Med. Jour.*, Sept. 19, 1885.

[2] "Du Sang," 1885.

[3] *Journal of Physiology*, vol. xvi., p. 468.

sible that the behaviour of anæsthetics towards the corpuscles, which it has been shown they affect so profoundly, may be such as to modify in a material degree their capacity for conveying oxygen to the tissues. The behaviour of anæsthetics towards corpuscles also illustrates a further and important point in our present consideration. There is a common tendency to accredit the central nervous system with absolute control over the vagaries of anæsthetics, to believe that if the ganglionic centres are keeping pace with the requirements of the organism that no fear of danger need be entertained. Certainly in the case of chloroform this belief is delusive. That body is a virulent protoplasm poison. Ether and nitrous oxide also act upon undifferentiated protoplasm, and all anæsthetic agents are able to influence living tissue, even when devoid of nervous connections.[1] Pickering, working with the embryonic heart, has demonstrated that not only does chloroform act directly upon tissues out of nervous control, but so far differentiates between them as to affect them in various degrees. For while chloroform depresses the rhythm, causing diastolic stoppages of the auricle and ventricle, it proves itself much more toxic to the auricle than to the ventricle.

[1] *Journal of Physiology*, vol. xiv., p. 446.

Ether stimulates the embryonic heart, although very large doses will eventually stop it in diastole. The frog's heart, again, can be removed out of the control of the nervous system, and can be again and again stopped with chloroform or ether, and while it is often impossible to restore it in the former case, it is difficult to kill it when ether is perfused.

It must be then that these anæsthetics are able, quite independently of the central nervous system, to act upon corpuscular and muscular tissue. Thiem and Fischer's research indicates that chloroform can produce a change in the heart muscle, which appears identical with fatty degeneration; while McWilliam[1] has proved that dilatation changes in the capacity of the heart as a whole, follow immediately on the inhalation of chloroform. These changes are also influenced largely by the actual quantity of chloroform contained in the blood as well as the length of time it has access to the tissues. It is further probable that the changes which we know take place as a result of alcohol, possess analogues in those brought about by other anæsthetics, and so that the nervous tissue is also structurally affected by them. Waller and others have demonstrated the changes in isolated ner-

[1] *Journ. Physiology*, vol. xiii., 1859.

vous tissue, but as yet no full research has been conducted upon the nervous elements as they occur in the body. An attempt was made in this direction by me in working out the physiological action of nitrous oxide[1] with results which, I think, proved the anæsthetic properties of that gas. It must then appear probable that the changes brought about in the blood elements react upon the more stable tissues by lessening their supply of oxygen while the tissues themselves are brought under the influence of the anæsthetic which the blood stream conveys to them.

The next changes which are brought about by the anæsthetic are those connected with respiration, circulation, and nerve regulation. In obedience to stimuli conveyed from the lungs, diminution of the amount of oxygen or its excess lead to corresponding respiratory efforts. In association with these are the somewhat complicated series of changes in the blood-pressure, the cardiac rhythm, the dilatation and constriction of the capillary areas which go to form the blood circulation. Not only may these be thrown out of gear by impediment to the pulmonary circulation arising from asphyxia, the commonest danger of anæsthetics, but may be profoundly

[1] *Trans. Odont. Society*, 1887.

affected from without through skin or visceral stimuli, leading to disaster. Oliver[1] by means of his ingenious instrument, the arteriometer, is able to record changes in the size of the blood vessels under various circumstances. He very kindly assisted me in some observations made at University College Hospital, and we found that during various stages of anæsthesia, the pulling upon the intestines, the spermatic cord, &c., incident to various operations upon viscera, produced the most startling changes in the diameter of the radial artery. This must indicate a profound series of impressions upon the control system. To my mind, many disasters under anæsthetics are explicable by these observations. Under chloroform especially, the shock conveyed by the removal of a tooth would, if the anæsthesia were not deep, in a certain number of cases, produce reflex inhibition of the heart. That this reflex inhibition does occur, has been proved by many observers, but the results of Amrus and Gärtner[2] are conclusive. Even where the animal is deeply anæsthetised, they found weak faradic currents applied to the vagus produced a very prolonged heart-stoppage. When the heart-pause had persisted for a certain time, respiration also failed, slight spasms succeeded.

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[1] "Pulse Gauging," 1895.

[2] *Wiener Med. Blätter*, No. 20.

In the paper to which I have referred above, Lauder Brunton insists upon a form of death under anæsthetics, which is certainly a common one, and which, when recognised, must relieve anæsthetics of responsibility in very many fatalities. Adopting Caspar's views he attributes these deaths to neuroparesis.[1] Not only do circulation and respiration fail simultaneously, but all the nervous centres are instantly annihilated. The death is one of shock. It may follow surgical shock; it may and does result from pain felt during imperfect anæsthesia, or even before any appreciable amount of the anæsthetic has been taken. I think a study of the cases of fatalities published will convince you that a large number of examples of death result from neuroparesis.[2]

Anæsthetics are, however, not simply dangerous *per se*. They too frequently have to be given to those whose tissues are already in a diseased condition. Take anæmia, fatty degeneration, "renal inadequacy," various functional and organic diseases of the ganglionic centres—of the heart—and cyanosis, the result of obstructive pulmonary or cardiac diseases, as examples of

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[1] "Neuroparesis," Lauder Brunton, *Lancet*, 1895, vol. ii., p. 23.

[2] See *British Journal of Dental Science* "On Nitrous Oxide Anæsthesia," Oct. 1 and 15, 1895; also "Clinical Report of Deaths under Chloroform," *Lancet*, 1893.

the many pathological states which place a patient, even before taking an anæsthetic, in a condition which renders him especially liable to suffer from such phenomena—caused by anæsthetics—as destruction of corpuscles, irritative inflammatory changes in the epithelium of the lungs and kidneys, fatty changes in the heart, regular and uncontrolled nerve storms. All such people must take an anæsthetic. And until we are fully alive to the way in which the several anæsthetics act upon persons so diseased we can neither select with accuracy nor control with precision, but must content ourselves with empiricism.

What, then, are the practical lessons our present knowledge teaches us? In general we must conclude that the action of the anæsthetic should be restricted within those clearly defined limits which involve only the higher ganglionic centres; that under no circumstances should incomplete anæsthesia be deemed sufficient for even the most trivial operation.

Of methods, our present knowledge allows us to say much, but it is impossible for me to do more than indicate in the briefest way what rules should guide us. All methods involving asphyxial symptoms are open to grave censure. In the case of all anæsthetics it is possible to produce unconsciousness, and yet to avoid

cyanosis. Nitrous oxide, once thought to be an asphyxiant, is now known to be a true anæsthetic, and to be capable to being given with oxygen or air, and to produce peaceful anæsthesia without any asphyxial phenomena. Of ether the same is true. Of chloroform it must be said that any association between it and asphyxia, must lead in the healthy subject to grave peril, in the diseased to fatal results.

A word further. Close study of the behaviour of anæsthetics makes me certain that all methods which employ a large quantity of anæsthetic substances are faulty. The pneumonia, the renal catarrh, the cardiac asthenia following anæsthesia are due, in most cases, not so much to the anæsthetic as to the unwary way in which it is employed.

When anæsthesia is better understood, and those who employ anæsthetics recognise more the responsibility they incur; when the Examining Boards demand of their candidates at least a nodding acquaintance with anæsthetics and their uses, then will there be fewer fatalities and more common-sense practice of this branch of the healing art.

Discussion.

Mr. Storer Bennett said Dr. Buxton's paper was full of suggestions in so many and such varied directions, he was sure he would not be misunderstood in alluding to only one or two of them; but in speaking on a paper such as this, one could only in a minute or two select one or two subjects. He wished to draw attention to two very interesting points brought out by Dr. Buxton. One was the solution of blood corpuscles that took place when chloroform had been administered, and the very happy explanation of those otherwise inexplicable deaths that occurred soon after the apparent recovery from the anæsthetic. It often seemed a mystery why a patient who had previously had an anæsthetic, apparently without any adverse results, and had recovered from its effects to a certain extent, died within a short time of regaining consciousness. They had hitherto no means of accounting for such unfortunate results, but the explanatian given by Dr. Buxton of the solution of the blood corpuscles seemed a most happy one. The second point to which he wished to draw attention, was to the sort of fatty degeneration that took place when chloroform had been administered on several occasions. This had a very practical bearing, for patients frequently stated that on more than one occasion chloroform had been administered to them, and urged this as a guarantee that it might be safely re-administered for dental operations. They seemed to think that having had it once, or twice, or thrice, without any unfortunate circumstances arising, would justify its being administered indefinitely. If, however, it was borne in mind, as explained by Dr. Buxton, that there was a

certain tendency to a process similar to fatty degeneration when chloroform had been administered, an additional reason would be forthcoming for declining to allow chloroform to be administered to their patients at all, and the fact of its previously having been successfully made use of would be no justification for administering it again. He heartily congratulated Dr. Buxton on his paper.

Dr. Hewitt said he had nothing to add except to say that he had listened with great interest and profit to the very brilliant *résumé* of the whole subject of anæsthesia which had fallen from Dr. Buxton's lips. He most fully agreed with his remarks. It certainly should be their duty, whenever they possibly could, to administer anæsthetics in such a way as to interfere as little as possible with the processes of life, and that was the point which was so admirably brought out in Dr. Buxton's paper.

The President said it only remained for him to tender the very hearty thanks of the Society to Dr. Dudley Buxton for his paper, and also to thank those gentlemen who had brought forward shorter communications that evening.

Odontological Society of Great Britain.

ORDINARY MONTHLY MEETING

February 3, 1896.

MR. DAVID HEPBURN, L.D.S.Eng.

PRESIDENT, IN THE CHAIR.

THE Minutes of the previous meeting were read and confirmed.

The following gentlemen were proposed as non-resident members of the Society :—GEORGE HENRY BOWDEN, L.D.S. Eng. & Glasg., Roseneath, Reigate, Surrey; T. RUBERY CHAMBERS, L.D.S.Eng., New-Inn-Hall Street, Oxford.

The following gentlemen were elected resident members of the Society :—FREDERICK LAWSON DODD, M.R.C.S.Eng., L.R.C.P.Lond., L.D.S.Eng., 41, Wimpole Street, W.; WALTER S. NOWELL, M.A.(Cantab), L.D.S.Eng., 41, Wimpole Street, W.

The following gentlemen were elected non-resident members of the Society: — ERNEST CATT, L.D.S.I., D.D.S. Mich., 11, Valley Bridge, Scarborough; W. FERGUS CORNELIUS, L.D.S.Eng., 29, Orchard Gardens, Teignmouth; EDMUND LEWIS DUDLEY, L.D.S.Eng., 14, The Circus, Bath.

The LIBRARIAN announced the receipt of the usual journals and periodicals, and *The Transactions of the Medical Society*, 1895; *The Calendar of the Pharmaceutical Society*,

1896; "Een Historische Schets der Tandheekunde," John E. Grevers; two pamphlets, "Handelingen van net Nederlandsch Tandheekundig Genootschap."

The PRESIDENT said he regretted to have to record the death of a member of the Society, Mr. George Gregson of Harley Street, who died about ten days ago. Mr. Gregson had been a member of the Society since 1857, and many years ago he filled the offices of honorary secretary and treasurer of the Society, member of the Council, and in 1884 he was elected a vice-president. He was well known, and his death would be a great sorrow to them all.

The CURATOR said: I have, sir, first of all to acknowledge the receipt of a skull of a crab-eating racoon, from Mr. Morton Smale, to whom we are already so deeply indebted for numerous specimens of comparative dental pathology. This is an interesting specimen, showing a supernumerary pre-molar in the upper jaw on the right side. Supernumerary teeth in the lower animals are not very common, but we have, as you will remember, at any rate one specimen in the Museum, that of the mandible of a gorilla, with two supernumerary teeth horizontally placed in the ascending ramus.

The Council has consented to the purchase of two specimens, one the skull of an old dog, showing a great deal of absorption of the alveolus with deposits of tartar, such as one commonly gets in pyorrhœa alveolaris. The other specimen is much more interesting, being the skull of a young baboon, just at the period when the first and second dentition are changing, and showing—as the result of rickets—very great thickening of the jaws and the other bones of the skull, which are developed in membrane. It is a very rickety skull indeed, and the teeth are erupting in consequence rather late and very irregularly. We had already, and have had for a good many years, a somewhat similar specimen in the museum, of a baboon with rickets, and I have placed the two on the table for comparison side by side.

Casual Communications.

Mr. Underwood described an artificial nose which he had constructed, and said he must apologise rather about this particular nose. First of all it was not so good as it might be, and he thought he saw his way to improving the method of painting it. Also it was not very easily removed. It was at present fastened on to the patient's face with spirit gum. She was in attendance, but before asking her to enter the room he would just briefly describe the way in which he arrived at that mode of attaching it. First of all he attempted, some few months ago, to make an artificial nose, and he did so with some sort of success, attaching it by means of spectacles. After that he made a rather more perfect one, a model being taken of the face in plaster and the nose modelled in wax and vulcanised, and then hollowed out considerably. Before vulcanising, small points of gold were inserted on either side of the bridge. These were tapped; a screw was introduced and fastened on to the bar of the spectacles, and so the whole apparatus was held in place. First of all he tried a very flexible band round the back of the ear, but finally had to resort to a rather harder one. This was all very well, but of course when the spectacles came off the nose came off too. There was also a little difficulty about the line of attachment. It necessarily showed most at the side where the spectacle band ended. He attempted to get over that by gumming wool, tinted as nearly as possible to nature, underneath the vulcanised attachment, and that did destroy the shadow to a great extent, for it was the shadow chiefly that showed at the edge. It appeared to him, however, that if there was any of the original structure remaining it would be much better to do away, if possible, with the spectacles, and he attempted to do so in that case by fixing the nose with spirit gum. This, of course, was not very permanent. It would be taken off with cold cream or spirit at night, and put on in the morning. That also, no doubt, did a certain amount of injury to the painting. It was not so permanent as he could wish, and he hoped later on to arrive at some

kind of enamelling which would bear all the washing and changing without destroying the colour. The patient was present but as she was naturally somewhat nervous, and the fastening and taking off the nose was a little tiresome, he was sure members would forgive her for simply appearing with the nose on. It had been put on that afternoon in the presence of the President, so that he would be able to corroborate the statement that the method of fixing was fairly simple.

The patient having entered the theatre, Mr. Underwood said the spirit gum lasted fairly well throughout the day, and would stand the ordinary changes of moisture and heat. At present the paint used was oil paint, and when it was dry he destroyed the glaze by means of a powder. The glaze, of course, would make it look extremely artificial, but that was got rid of by means of a powder prepared by Mr. Martindale, which really produced a fairly good result, but was at present not very durable. One great advantage of this new arrangement was that they could do without the spectacles, for having to remove the nose with the spectacles was a little bit of a drawback. At the distance from which the patient was seen by most of the members the result appeared very good, especially with the veil down.

The patient having left the room, Mr. Underwood exhibited models of this and other cases. He said the case just seen was a case of lupus, which had been cured.

Mr. R. H. Woodhouse exhibited the model of a case of fracture in the bicuspid region as a result of a blow on the chin. The patient was a boy, age 14 years, who in playing football was violently struck on the chin by the head of another boy. From the force of the blow the bicuspids on the right side of the mouth were fractured, the inner cusps being knocked off, but on the left hand side the second bicuspid was completely fractured through the pulp chamber. The boy suffered a great deal of inconvenience from it for a few days, and then he had to have it taken out. When seeing the patient about a week after

the accident, although he had had such a severe blow, there was nothing on the face to indicate it, and possibly he had to thank the fracture of his bicuspids for saving him from fracture of the condyles of the jaw.

Mr. C. F. Rilot reported a case of football accident as follows:—A patient came to me this afternoon with the history that he had been playing football on Saturday, and had been kicked in the mouth. His mouth was rather swollen, but there was no injury to the soft tissues. I examined his teeth, and found the two upper central incisors apparently very loose, considerably elongated in their sockets, and leaning somewhat inwards. On probing, I found the right one was fractured high up; the left one felt as though fractured, though I could not actually be sure of the fracture by probing. The teeth were extracted, the coronal portion coming away quite distinct from the apical portion in each case. On examining the fragments there is distinct evidence of absorption, the apical portion of the pulp in each case being expanded into a large, fleshy mass, presumably of absorbent functions. The patient now volunteered the remark that he had had an exactly similar accident two years before. The teeth had been painful for a time, but that passed off, and beyond a slight elongation, they had been quite right until last Saturday. It is quite evident, on looking at the specimens, that the fractures must have taken place at the time of the first blow, two years ago, and the interest of the case lies in the fact that these teeth should have been perfectly comfortable for two years under these conditions.

Notes upon Dentine and Enamel.

By Charles S. Tomes, M.A., F.R.S.

During the past year a very interesting series of papers have appeared in the *Dental Cosmos* from the pen of Dr. Black, in which, amongst other things, he has endeavoured to ascertain the nature of that difference between teeth of good and bad quality which is recognised as existent by every dentist of any experience.

The idea generally has prevailed that, just as occurs in rickety bones, there was a deficiency in lime salts in teeth of poor quality; and but little had been done in the way of actual experiment towards the determination of this point, although Dr. Black appears to have overlooked the valuable papers of Dr. Galippe, who was the first in the field in experimenting.

Dr. Galippe's experiments were undertaken with whole teeth, which was in some degree unfortunate, as it was always possible that differences in some of the tissues might be more or less completely masked by their not being common to all; moreover, he adopted the methed of ascertaining the specific gravities of the teeth,

which, according to him, corresponded in a rough way with the proportions of lime salts present.

According to Dr. Galippe ("Recherches sur les Propriétés Physiques des Dents," Société de Biologie, 1884) the milk teeth have a lower specific gravity than their successors, and also differ in containing a larger percentage of carbonates; the roots of teeth also have a less specific gravity than their crowns, and he also believes that their density increases with age. He also holds that teeth of the right side have a slightly greater density than those of the left, and molars a greater than incisors.

When Dr. Black's researches were undertaken, little beyond this was known as to the constitution of teeth, and they hence constitute a valuable contribution to the subject.

His investigations covered a great deal of other interesting ground, but for the present I am concerned with one aspect of the question only, namely, that of the chemical constitution of the teeth.

Dr. Black procured teeth from mouths where the teeth were conspicuously free from caries, and from others where the teeth were decidedly carious, and adopted a uniform method of examining them. He cut transverse slices from the necks of the teeth, considering that in that position his results would be but little interfered with

by the presence of enamel or cementum, and that they would therefore give good comparative results.

The slices were dried for an adequate length of time at a temperature of 100° C., and then incinerated, first on gauze and then in a platinum crucible, and the loss of weight set down as organic matter.

I have elsewhere (*Journal of the British Dental Association*, 1895) given grounds for thinking that the technique adopted was not calculated to give the most accurate results which could have been obtained; nevertheless his results are set out in his tables with a degree of minuteness which far transcends the possibilities of experimental accuracy, even had the technique been as perfect as could be. Still the broad results are, I think, quite trustworthy, and, at all events, striking out the decimal places, may be accepted as accurate.

Dr. Black's results give as a general average 72 per cent. of lime salts (leaving out as untrustworthy his second place of decimals), and, which at first strikes one as remarkable, he found no deficiency in lime salts in the teeth of imperfect quality. This led me to undertake a series of check experiments, endeavouring to eliminate every source of error of which I could think.

In order to get dentine, and dentine only, the teeth were sawn across at their necks, and as

much dentine as could be got without danger of contamination with enamel or cementum, cut out with spear-headed drills and collected as fine turnings.

These were dried in a constant temperature for over eight hours at 100°C., weighed in a platinum crucible, ignited in a muffle, and weighed again. The ash was then moistened with ammonium carbonate, in order to restore any carbonic acid which might have been driven off by ignition from the carbonates present, then dried and weighed again. The general result was an average of 72·5 per cent. of lime salts. In these experiments the turnings remained from first to last in the crucible, so that there was no chance of loss, and the amount of dentine obtainable from each tooth was quite twice as much as the quantity experimented with by Dr. Black, this again, of course, tending to diminish error.

One of the most surprising statements in Dr. Black's paper is that teeth taken from the same mouth differ in the percentage of lime salts more largely than do teeth of good and bad quality. This seemed so unlikely, that I took four or five jaws in which all, or almost all, the teeth were present, and estimated the salts in each tooth, or in each pair of teeth. As I soon found that the two central incisors, two lateral, or any other pair of teeth gave pretty closely the same result,

I am inclined to think that Dr. Black is mistaken in supposing that these differ, and that the difference is due to experimental error. I therefore in my later experiments mixed the turnings from each pair of teeth, so as to get a larger quantity to deal with. The following are some of my later results.

(1) A perfect dentition (upper jaws) in which M_3 is not yet erupted.

	Percentage of lime salts.
Central incisors	70·0
Lateral incisors	69·7
Canines	70·8
Bicuspids	72·0
First molars	72·7
Second molars	72·9

(2) A perfect dentition in which only one wisdom tooth is erupted.

Central incisors. ..	64·5 (probable error)
Lateral incisors ..	72·9
Canines	72·8
First bicuspids ..	74·8
Second bicuspids ..	74·8
First molars ..	74·6
Second molars ..	74·5

(3) Perfect dentition, a good deal worn.

Right central and lateral incisors	70·5
Left central and lateral	70·4
Right canines	72

Left canines	72
Right bicuspids	72·7
Left bicuspids	72·8
Right molars	72·3
Left molars	72·3
Right and left wisdom teeth ..	71·8

(4) Nearly perfect lower dentition. Instead of making an ignition the dentine turnings were subjected to the action of strong nitric acid, and heated so as to drive off the acid. This left a perfectly white ash, which was treated with ammonium carbonate, to restore any lost carbonic acid.

Central and lateral incisors ..	75·6
Canines	75·6
Bicuspids	75·3
First molars	79·3
Second molars	77·2
Third molars	77·0

It will be seen that these percentages are higher, probably owing to the retention of some water. As a matter of fact, ignition subsequently brought down the percentage of the molars to 73, but owing to an accident to the muffle the others were lost.

(5) The incisors much grooved; two bicuspids and one wisdom tooth deeply carious; slight interstitial caries upon many of the teeth.

Central and lateral incisors ..	70·9

Canines	71·2
Bicuspids	71·2
Molars (first)	72·1
Second molar	71·9
Third molars	72·0

It will be noticed that in this, the only series of imperfect teeth examined, the percentages rule lower than in the others, and this, so far as it goes, does not confirm Dr. Black's conclusion that teeth of poor quality are quite as highly calcified as those of good. But, on the other hand, the differences are small, and a single series does not establish much, so that this question must be left still *sub judice.*

It is suggested by Dr. Black, that the difference between good and bad teeth is, probably, to be sought in the organic matter; there are, however, other possibilities. Thus, it may be in the proportion of combined water, or in the proportion of the different lime salts present, as, for example, in a greater proportion of carbonates. This, however, is a point very difficult to determine, as the estimation of carbonates present in very small quantity is open to much experimental error. Or, again, it is conceivable that the dentines may be identical, but the enamels different.

But there is one point which my investigations bring out very plainly, and that is, that the

molars and bicuspids are more highly calcified than the incisors and canines.

Taking the averages from all the ignitions which I have performed, there comes out this result.

	Percentage of salts.
Incisors and canines	71·5
Molars	73·2

Upon returning to Dr. Black's published tables and getting out the incisors and molars, I found these averages:—

Incisors and canines	71·7
Molars	72·3

I should say that in making comparison with Dr. Black's figures, which are percentages of wet dentine, I have corrected them into percentages of dry dentine, as all chemists are in the habit of giving analyses of substances deprived of free water. Thus, though Dr. Black has not noticed it, his figures serve to confirm my result, and it may be taken as pretty well established, the more so as Dr. Galippe's specific gravity experiments on entire teeth point to the same conclusion.

It would be interesting (and I intend to investigate the point) to know if this is general throughout the animal kingdom. But, as ivory is known to contain a specially low percentage of salts, I compared the salts contained in it and in the dentine of an elephant's molar, with the following result.

Ivory (tusk)	57·5
Dentine of elephant molar ..	70·2
Cementum of elephant molar ..	67·0

Thus, then, whilst ivory is very rich in organic matter and water, the dentine of the molar differs little from human dentine. The tusk, which requires elasticity, but is little subject to attrition, has few lime salts, and the dentine of the molar which is required to be hard—harder than the cementum—is highly calcified; and the cementum stands between the two in this respect

Passing from these examinations which were all carried out upon the line of destruction of the organic matrix, I approached the matter from the opposite direction, and dissolved out all the salts by the careful use of dilute acids.

The decalcified matrix was carefully washed and dried and then weighed. This gave a result at first sight not consistent with the ignition experiments.

Thus in the case of ivory:—

Lime salts (ascertained by ignition)	57·5
Dry collagen	34·0
Deficiency	8.5
	100·0

This deficiency was ascertained to be water in combination, that is to say, water which could not be dried out.

Other experiments gave as much as 9·5 per cent. of water; if this latter figure be correct, there is an amount of water in ivory sufficient to form three equivalents in combination with the tribasic calcium phosphate, the formula of which would be $Ca_3\ P_2\ O_8$, $3\ H_2\ O$.

It is of course well known that calcium phosphate prepared by wet processes, always contains one or more equivalents of water, the last of which is only lost at red heat.

A similar course of procedure with human dentine gave

Salts	72·0
Collagen	19·6
Deficiency (water)	8·4
	100·0

Now one equivalent of water in combination with the calcium phosphate, supposing that all the 72 per cent. of the salts were calcium phosphate, which of course they are not, would require 3·9 per cent., so that there is not enough to form three equivalents of water.

There are great discrepancies in analyses of dentine, but all agree that there is some carbonate, and some magnesium phosphate, reducing the percentage of calcium phosphate down to 67 or 68 per cent. or according to some, even lower; if that be the true proportion of calcium phosphate, the

water is not far off the quantity required for three equivalents.

Hence, I am inclined to believe that in dentine the calcium phosphate holds, in chemical combination two or three equivalents of water. But the definite determination of this point would need more careful analyses of rather large quantities of dentine.

But at all events this is clear, that the analyses of dentine as usually set out are wrong, in that a good deal of water is set down as organic matter, and that instead of setting down the combination of ivory as—

Lime salts, &c.	57·5
Organic matter	42·5 per cent.

We ought to write—

Lime salts	57·5
Organic matter	34·0
Water	8·5

or

Organic matter, and water in chemical combination	42·5

The collagen obtained was boiled for some time in water acidulated with acetic, or weak hydrochloric acid; this brought the collagen into solution, partly changing it into gelatine, and left an insoluble residue of flocculent appearance which consisted, as determined by microscopic examination, of Neumann's sheaths in a detached condition.

This residue, consisting, as shown by chemical tests, of elastin, was found to constitute as much as 1·2 per cent. of the entire dentine in the case of ivory, and therefore formed quite 3 per cent. of the dried collagen.

Before leaving the subject of dentine, I may mention that some tooth pulps from a calf were dried and ignited; the dried pulps were found to contain 10 per cent. of lime salts, mostly phosphates; there is then in the pulp a rich store of lime to draw upon for the purpose of calcification.

Blood plasm contains about ·8 per cent. of salts, but these do not largely consist of phosphates; dried blood plasm would contain a total of salts of about 8 per cent. in round numbers.

My observations upon enamel have been already published elsewhere, in the *Journal of Physiology*, but I may mention that I have found it to be practically an inorganic tissue; the small percentage which has usually been set down as organic matter being, in fact, mainly water, and the organic matter present being only in the most infinitesimal proportion — far too little for quantitative estimation.

Just as in the case of dentine, it is probable that the calcic phosphate has an equivalent of water combined with it, and this is driven off with such suddenness, just before red heat is reached, as to make the enamel fly about.

An average analysis of enamel from an elephant's molar would give—

Lime salts, &c.	94·51
Water and traces of organic matter..	5·49

Calcining enamel leaves its structure but little altered. If it be not carried beyond bright redness for ten minutes or thereabouts, the enamel prisms still remain quite distinct and unaltered in size or form. They do, however, acquire a greater opacity, and a slightly granular appearance, so that it seems as if the driving out of the combined water had altered the crystaline structure.

Fig. 1 represents scrapings of enamel from an elephant molar, as yet incomplete, which have been thus calcined.

It has long been known that the shells of certain molluscs present a prismatic structure not unlike that of enamel, and the shell of the large mussel Pinna is a fine example of this (fig. 2).

Thinking that it might throw some side light upon the structure of enamel, I examined the Pinna shell, in which the calcifying material is carbonate and not phosphate of lime, and in which the prisms are of great size.

The prisms of Pinna present a further resemblance to those of enamel in that the individual prisms show a transverse striation, which has

PLATE 1.

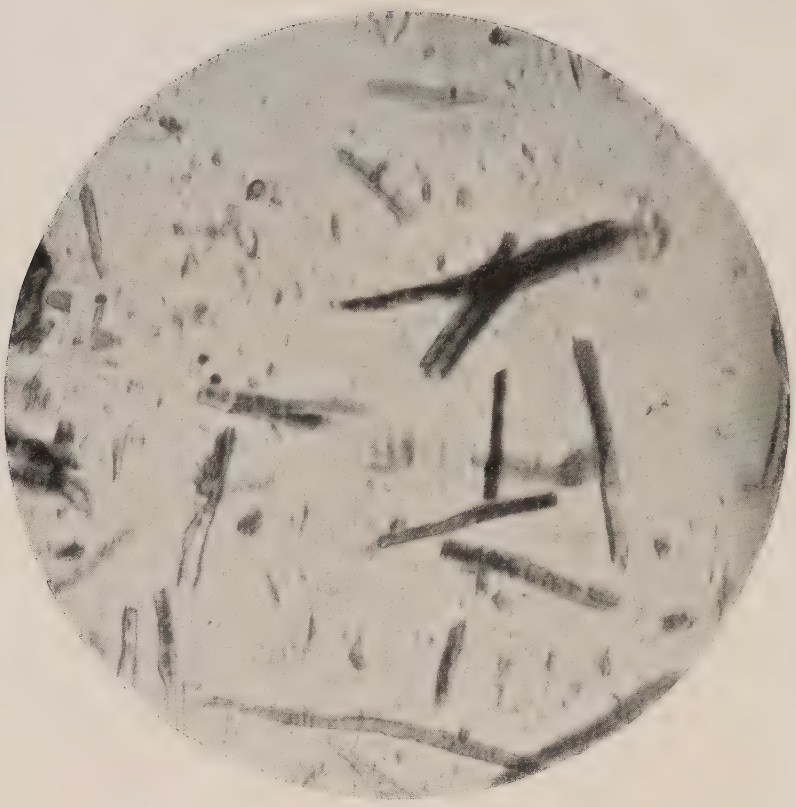

Fig. 1.

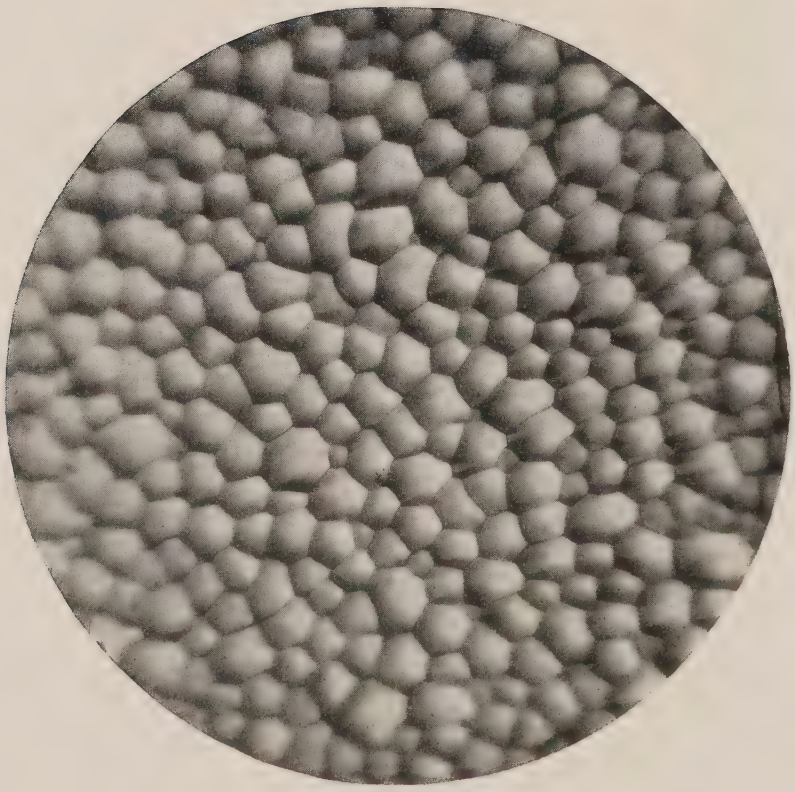

Fig. 2.

FIG. 1.

Scrapings from the enamel of a young elephant molar, calcined. This shows isolated enamel prisms, which differ only from similar scrapings before being calcined in that the prisms have become more opaque and granular. Photographed by Mr. Mummery.

FIG. 2.

Section of shell of Pinna cut transversely to the prisms. From a photograph taken by myself.

been beautifully brought out in the photograph figured, which was taken by Mr. Mummery (fig. 4).

A careful examination of these large Pinna prisms seems to indicate that the striation is due to regularly recurring varicosities of the prism. This tends to confirm the view more recently advocated[1] as to the cause of striation in human enamel—a view which is adopted by Mr. Leon Williams, and is illustrated by the very beautiful micro-photographs which he has been kind enough to lend me for exhibition here this evening.

On decalcifying Pinna shell I found that the organic residue forms a conspicuous and bulky mass, swelling up considerably when the lime is removed.

Yet this conspicuous and bulky mass proves to amount to only 1 per cent. of the weight of the shell, which is a confirmation of the conclusion that there is practically no organic matter in enamel, which, as is well known, wholly disappears on decalcification. An analysis of Pinna shell gives.

Lime Salts	89·2
Organic matrix	1·3
Water	9·5

[1] "Dental Anatomy," Tomes, 1894, p. 17.

The organic residue has the appearance under the microscope of a delicate connective tissue. In order to investigate more satisfactorily its arrangement I ground a section transverse to the prisms, and cemented it down to a slide with canada balsam.

This was carefully decalcified, a little ferric chloride being added to the fluid ; after washing it was treated with tannin solution, with the result that a beautiful honeycomb, corresponding exactly to the appearance of a simply ground section was obtained, except only that the strongly refractive material which constituted the prisms was wholly gone.

It was thus shown that the Pinna shell consists of crystalline prisms of calcic carbonate containing no organic matter in themselves, but deposited in a honeycomb of connective tissue.

I should have mentioned that in a transverse section of shell the interstitial substance between the prisms is of material width, and the interstitial substance between enamel prisms of course is not.

A section of enamel was then treated in precisely the same way, with the result that nothing whatever could be distinguished upon the slide —all had disappeared.

In the absence of definite knowledge, save that a trace of interstitial matter can be stained in

sections of human enamel (Bödecker and Heitzmann), and that a similar tissue can be demonstrated in epithelium—moreover that a trace of mucin can be got from enamel, as I have shown in the paper referred to above—it seems a legitimate speculation that enamel may be formed on lines somewhat analogous of the Pinna shell, namely, that the lime salts may be deposited in the interior of the enamel cells, and so a definite pattern produced, their exceedingly delicate walls playing the same part as the connective tissue honeycomb in the shell, and that the comparative absence of organic material in the finished product may be due to their exceeding tenuity as well as to the absence of organic matter from the prisms themselves, which are purely crystalline.

Such an explanation seems to me to fit in with all known facts, and serves to easily account for the complex arrangement of the prisms in definite patterns which would, on ordinary excretion views, be a little difficult.

My own analyses, and this view if it be true, afford an explanation of enamel structure quite at variance with that held by Heitzmann and Bödecker (which indeed the analyses alone seem sufficient to refute), and they fit in well with the explanation offered by Klein of the microscopic appearances.

And although the subject requires much more

PLATE 2.

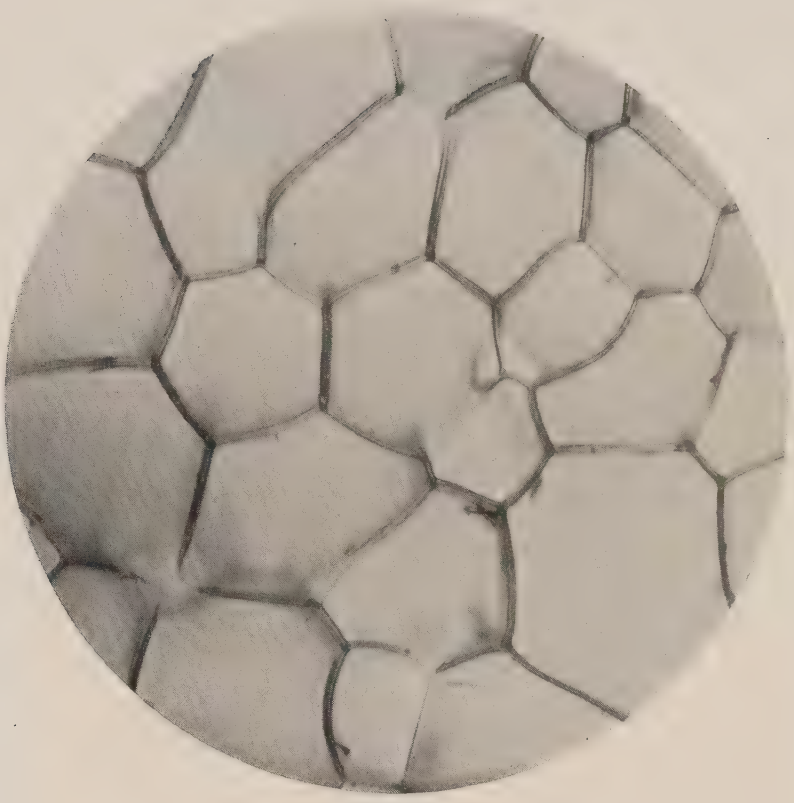

Fig. 3.

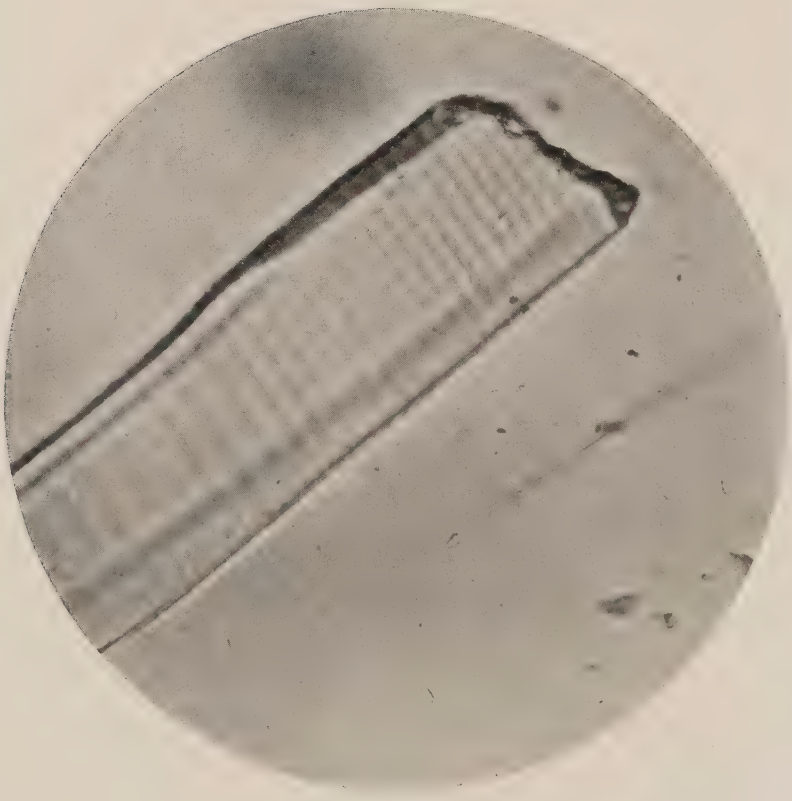

Fig. 4.

FIG. 3.

Section of shell of Pinna which had been ground thin, cemented to the glass and decalcified *in situ*. It shows the connective tissue reticulum in which the prisms were deposited, and the walls of the honey comb are in places seen in perspective, showing their depth in the thickness of the section. Photographed by Mr. Mummery.

FIG. 4.

Isolated prism of Pinna shell. This shows very distinctly the transverse striation of an individual prism.

investigation, it seems very possible that the difference between good and bad teeth may reside principally in the enamel. We know that enamel formation is very sensitive to health disturbances, inasmuch as these become written upon it in the form of lines of imperfect structure when acute illness has happened during its deposition, and we know also that in teeth of poor quality it is easily cut and is friable, so that we have a difficulty in getting good edges to our cavities. But while it is tempting to indulge in what the late Professor Tyndall called the scientific use of the imagination, I would not be understood to build too much upon anything which goes far beyond a demonstrable experimental basis.

It is said by Dr. Galippe that entire teeth contain about ·4 per cent. of silica, but this point I have not so far investigated sufficiently to enable me to speak with any certainty. If, however, it be present, I am inclined to think that it is only in smaller traces.

Discussion.

Mr. Leon Williams said he really did not come expecting to be called upon to say anything, and he was sure he was not in that frame of mind which could best express any critical opinion on what they had heard. He was too much pleased with what Mr. Tomes had said; pleased because he knew from what he had seen, that Mr. Tomes' analyses of dentine and enamel were the most careful and the most critical that ever had been made, and pleased also because it always gave a little added feeling of delight to be able to to say, "I told you so." He believed that he (Mr. Leon Williams) had been on record a number of times during the past fifteen years as affirming the position which Mr. Tomes was able to take after the analyses he had made of enamel based entirely upon deduction from microscopic observation, also based upon Dr. Miller's work. Some members would undoubtedly remember the controversy that he (Mr. Leon Williams) had in New York with Heitzmann and Bödecker on that point, for not long since he stood almost alone in criticising what he regarded as the very unwarrantable claims made with regard to organic matter in enamel. The result of the analyses before them opened up a very wide field for investigation, and they certainly served to modify very much the views which had been held with regard to the causes of decay in teeth. It seemed perfectly evident that these analyses were in line with Dr. Miller's observations and conclusions with regard to the causes of decay in teeth, viz., that they should look very much more to the environment of the teeth than to the inherent structure, in finding out the causes of dental caries. It would be regarded, doubtless, as a very heterodox state-

ment if he were to say that in his judgment the most imperfectly formed teeth, so far as inherent structure was concerned—and he meant by that the proportion of lime salts which they contained, or anything other than the grosser defects, such as were found in the enamel—in a perfectly healthy mouth would never decay, and yet it appeared to him that that was exactly the conclusion arrived at by Mr. Tomes and by Dr. Miller, and that in an unhealthy mouth—and by unhealthy he meant those conditions inimical to the preservation of teeth—in such an unhealthy mouth the most perfectly formed tooth would never be able to resist decay. If they might take these as the conclusions which they were able to reach, they would have a very direct practical bearing upon the whole treatment of caries of the teeth. With regard to what Mr. Tomes had said concerning the formation of enamel, he would rather not enter into that point, for to say anything in a satisfactory way would take up too much time. He was at the present moment engaged in an extension of the paper that he presented before the Royal Society, stating his views more at length than it would be possible for him to do on that occasion. He therefore asked them to excuse him saying anything further.

Mr. Goadby said: I have listened with much interest to Mr. Tomes' paper, partly because of the excellency of the paper, and partly as I have been for some time past working at the same subject. Mr. Tomes referred to the sheaths of Neumann as elastin, this I can confirm, having worked out their reactions myself; in fact, I showed my notes to Mr. Maggs some time before Mr. Tomes' paper was first read; but the interesting point in regard to the sheaths is this, in caries the micro-organisms are always found along the dentinal tubes, in front of the main caries, whilst they are always situated along Sharpey's fibres in caries of cement. Now Wälchli has shown that when elastin is decomposed by bacteria, glycocoll or amido-acetic and amido-valerienic acids are produced by the breaking down of the elastin molecule, besides the peptonising action. But glycocoll, in common with other amido acids,

has the power of forming compounds with calcium salts, so that *pari passu* with the disintegration of the tooth substance by, say, lactic acid, formed from extrinsic sources, an intrinsic acid production is going on. In several cultures of bacteria isolated from the mouth I have obtained a reaction characteristic of the amido-acetic series, so it seems quite possible to admit that the process of caries is aided in this way. Moreover, amido acids form crystalline compounds, so that, as we have only peptonised chondrin and elastin, and little or no albumin, while the factors of crystalline (pure or impure), compounds are present as amido acids and salts of lime, some of the masses of substance, supposed to be calcospherites, may be these impure crystals.

Mr. MUMMERY said he knew very little about the chemical part of this investigation that had been undertaken by Mr. Tomes. It was an investigation of great interest, and had shown some very important points. With regard to the structure of enamel, it might possibly indicate that the enamel was formed by secretion and not by conversion. Mr. Tomes said it seemed to prove that the enamel was formed in the enamel cell. It might possibly be that the lime salts were secreted by the enamel cells. Of course, this was a view that had been held by many with regard to dentine and known as the secretion view. This new discovery of Mr. Tomes might point to either one or the other, but it did not seem to quite upset the secretion view. Of course the point about the molars being more fully calcified than the other teeth was a matter of great interest, and appeared to be very surprising when they thought of the conditions met with in the mouth.

Mr. C. S. TOMES in reply, said he had already detained the Society so long that he would not say much in addition, and there really was nothing very much to reply to. It was exceedingly interesting to him to hear of the action of the bacteria upon elastin, in breaking it up into an amido acid, which was new to him. It was particularly interesting from this point of view, that, knowing how exceedingly resistant a substance elastin was to weak acid, it had

always been a difficulty in one's mind to understand exactly how it did get dissolved, and that difficulty Dr. Miller had accounted for by the peptonising action on the part of some of these bacteria—that the elastin having resisted the acid could probably be easily dissolved by something analagous to a peptonising process on the part of the bacteria. He had omitted in his previous remarks to mention the bearing of his paper upon the formation of enamel, which had been touched upon by Mr. Mummery, as to whether it was a conversion or a secretion. Supposing his guess to be correct, that the lime salt, this calcium phosphate, was deposited inside the enamel cells, it still might be regarded either as secretion or conversion. It might be split between the two; the difference might become narrowed until it became a question of terms.

The PRESIDENT said it only remained for him to propose a hearty vote of thanks to those gentlemen who had contributed Communications, and more especially to Mr. Tomes for his Paper, which opened up so wide a field of research in the future.

Odontological Society of Great Britain.

ORDINARY MONTHLY MEETING

March 2, 1896.

MR. DAVID HEPBURN, L.D.S.Eng.

PRESIDENT, IN THE CHAIR.

THE Minutes of the preceding meeting were read and confirmed.

The following gentlemen having signed the necessary obligation forms, were admitted members of the Society:—ERNEST CATT, 12, Valley Bridge, Scarborough; W. FRYER CORNELIUS, Orchard Gardens, Teignmouth; E. L. DUDLEY, 14, The Circus, Bath.

The following gentleman was duly elected a member of the Society:—HAROLD DEWE MATHEWS, L.D.S.Eng., Grove Field Villa, Cheltenham.

The following gentleman having signed the obligation book, was admitted a member of the Society:—WALTER S. NOWELL, M.A.Oxon., L.D.S.Eng., 41, Wimpole Street, W.

The LIBRARIAN reported the receipt of the usual periodicals, also of the *Journal of the Bristol Medical and Chirurgical Society* for 1895.

The CURATOR: I have to present to the Society, for its museum, a model from Mr. Beadnell Gill, showing three upper temporary laterals, two on the left side and one on the right. It is a very interesting specimen, since irregu-

larities of any kind amongst temporary teeth are so much rarer than amongst permanent ones.

In response to the appeal made some time ago, six old pieces have been sent to me, some of them containing natural teeth mounted on bone, and others containing porcelain teeth similarly mounted. Unfortunately, they arrived whilst I was ill last autumn and the name of the donor has been lost; if he will be good enough to communicate with me I shall have great pleasure in seeing that his name is attached to the specimens.

A third specimen has been sent by Mr. Vacey Linnington Hope, and is part of the left half of the mandible of a cave bear containing a canine and a lower molar; the specimen was found in the Riviera under fifty feet of stalactytic limestone. From the same neighbourhood, two or three years ago, three very interesting skeletons were discovered in a nearly similar situation, one of a man and two of women, and were described by Professor Jennings. Very great interest attaches to these skeletons because the man was over 7 feet 4 in., and the women 6 feet 4 in. and 6 feet 6 in. in height. Of course these specimens all date from times so remote that they must go back many hundreds of thousands of years ago.

Dr. Wallace said he had very much pleasure in presenting half of the skull of a female tapir to the museum. It was only half a skull, but it was all he had got, and he hoped the Society would accept it on the principle that "half a loaf was better than no bread."

Mr. Storer Bennett: I have, sir, to bring to your notice a case which illustrates the dangers that sometimes attend the injudicious use of elastic bands, in attempting to move teeth from one position to another. In this case, a young lady, about 13 years of age, was under my treatment for retraction of the upper teeth, in consequence of great superior protrusion. Unfortunately, her health being very bad, every now and then the apparatus she is using is thrown on one side altogether. In the beginning of last July it was arranged to take her to the seaside for three or

four months. I therefore decided, as I was attempting to draw back the upper canines, to cement on two collars to the first molars and canines on each side, and connect them by elastic bands.

The first model shown on the screen illustrates the case before I commenced the treatment. The next shows the result. The gold collars have tilted forwards, the first molars on each side, and the canines drawn back to the second bicuspids, have unfortunately also become considerably rotated outwards. The bands which ought to have been attached to the palatine side of the collars were entirely neglected by the patient, with the result that traction was only made on the outer side and hence the rotation.

The points I wish to accentuate are, firstly, the danger of leaving patients to look after regulation cases for themselves, though as in this instance, the risk had to be run; and, secondly, the very curious effect produced on such large teeth as the first molars in tilting them forwards.

Seeing that we were going to have the subject of evolution before us this evening I thought it might be interesting to members to see two models which I took some years ago from the mouth of a lady, age 33. There are in the upper jaw two permanent centrals and one molar, with three temporary teeth; and in the lower, a right lateral and canine and five milk teeth. The five permanent teeth mentioned being the only members of the second dentition ever erupted. This case is the more interesting from the fact that I am informed her sister has a very similar dentition.

The next slide is a photograph of the skull of a white-nosed monkey, showing an appearance which bears somewhat on the last specimen, being a case of suppression of the upper incisors. The skull is almost an adult one, the canines being nearly erupted, but there are no permanent incisors, and the alveolar ridge is so thin and small as to convince one that the teeth are not present in the jaw at all. There are, however, two temporary laterals. Irregularities of dentition amongst the lower animals, of course, are rare, but as far as my experience goes they are not as rare as people generally imagine.

The last slide I wish to show represents the skull of a monkey with only one upper central incisor occupying the median line. Whether the other one was ever developed and lost as the result of accident, or whether it has been suppressed, the appearance of the specimen hardly justifies one in definitely stating. I have much pleasure in presenting these two skulls to the Society's Museum.

Mr. J. F. Colyer: Mr. Bennett said he extracted the molars as shown in the second illustration, but he did not explain the reason why.

Mr. Storer Bennett: I took them out because they were very much decayed, and there was no possibility of getting the front teeth back sufficiently without. It is one of the very worst cases of superior protrusion I ever had to deal with.

Mr. Sidney Spokes asked whether in the case of the patient referred to there were any other signs of suppression in the dermal appendages; whether her hair was luxurious or the opposite.

Mr. Reinhardt mentioned the case of a lady, age 26, who had only five teeth in both jaws. He saw her some time ago and did not remember distinctly which they were, but there were only two permanent teeth among the five. She had a luxurious crop of hair and her nails were all right.

Mr. Storer Bennett said there was nothing remarkable in the case about the dermal appendages, the hair was neither specially thick nor at all scanty. There was nothing at all abnormal excepting the teeth.

Mr. Charters White said a case was brought before the Society some years ago, in which a similar abnormality in the teeth was associated with a profusion of hair all over the face.

The President said he remembered the case, and also a very marked instance brought forward by Mr. Oakley Coles, of a Russian family, known as "the hairy people," whose faces were entirely covered with hair. One of the family, a

Mr. Storer Bennett's case of suppression of the Upper Permanent Incisors in an almost full-grown Monkey.

Mr. Storer Bennett's case of the absence of Left Upper Permanent Incisor in an adult Monkey.

child, age 7, had some three or four central incisors, while the father had never erupted more than some four or five rudimentary sort of teeth in the front of the mouth. He believed there were other instances on record where this peculiarity had been associated with an abnormal development of hair.

Mr. Blain exhibited specimens of Dr. Martin's "Prothese Immediat." They were made, he said, for the superior and inferior maxillæ, and consisted of temporary apparati to be placed in position during the operation of resection of the jaw, together with more permanent appliances for use when the wound was thoroughly healed. An enlarged segment of the maxilla was made in advance, and when the diseased portions were removed the apparatus was cut to a suitable size and shape, taking care that it was somewhat larger than the bone, which had been removed. The apparatus was permeated with irrigation canals, through which antiseptic fluids were forced at a medium pressure, thereby obviating the necessity for iodoform and other dressings in the mouth, which rapidly became infected with the saliva, while the taste of the drugs tended to take away the patient's appetite.

The apparatus for the lower jaw was composed of two parts representing (1) the body of the jaw and the ascending rami; (2) the alveolar border, which, in the temporary cases, was made of rubber to allow the articulation to be made.

When the ascending rami, &c., had been removed, the piece was held in position by the help of springs attached to a plate in the upper jaw. When some of the maxilla and rami remained, the appliance was fixed to the bone externally by means of plates screwed into the bone, and internally by a plate, which held it in position.

The permanent piece was, of course, made in the ordinary way, and furnished with teeth to improve the appearance. Care should be taken that if the piece was too large to be withdrawn whole it should be made in two parts.

For the upper jaw, the apparatus was composed (1) of the palate and alveolar border, and (2) of the anterior

external part of the superior maxilla, and nasal and malar bones, and floor of the orbit, which last part was composed of two parts, so that it could be easily withdrawn.

When the parts were thoroughly healed, a different apparatus was required to enable the patient to speak distinctly.

The impressions might be taken either in plaster or stent. If the latter was used, small pieces were taken warm and pressed into the cavity; when cold, it was taken out and the parts fitted together and the model constructed in the ordinary way.

Mr. J. F. Colyer said he had endeavoured on four or five occasions to make appliances of this kind. He wished to ask Mr. Blain whether these instruments, which in themselves were very beautiful specimens, were in practice found to be useful? No doubt the upper jaw was very well reproduced, but he thought that when contraction took place the instrument must be almost useless. He also wished to know how far such appliances would tend to interfere with the healing of the tissues, and whether the action of the muscles on both sides would not pull across the two halves towards the median line, and thus have a very prejudicial effect upon the portions that remained? In one case, where Mr. Boyd removed half the lower jaw for myeloid sarcoma, a plate was put in the lower jaw on the affected side with a spring playing to the opposite side with a view of counteracting the tendency to displacement. Theoretically, the thing was perfect, and it worked very beautifully, but within three days the boy got absorption taking place rapidly on the free margin of the portions remaining, where the plates came. He would also ask whether these appliances were beneficial where portions of jaw had been removed for malignant growth, because looking at them simply from the common-sense point of view there were plenty of points about them which would certainly cause a large amount of irritation to the tissues. He had been working with Mr. Boyd on two or three cases of the kind, but his experience was that though theoreti-

cally they were very pretty, practically they were quite useless.

Mr. Blain, in reply to Mr. Colyer's question, said one point of usefulness was, especially in the case of the lower appliance, that it did away with the effect of having dressings inside the mouth, which were not only prejudicial to the patient's appetite, but also soon became very foul. The patient might have some time to live, and the relief given seemed to make his life happier. With reference to the contraction in the upper, it no doubt went on to a certain extent. Dr. Martin, however, found in his experience that, generally speaking, it was very slight. He had had several successful cases, and in one the patient had worn a permanent apparatus for about ten years, and the contraction was very slight indeed. With regard to any irritation, there was certainly a tendency in that direction, but if the piece was firmly screwed in, the irritation was, after all, very slight, if the apparatus was thoroughly irrigated with antiseptics.

Mr. Davis exhibited an artificial nose constructed by Mr. Bond, of Brixton. He said that the patient was in attendance, but being extremely sensitive, declined to present himself before the meeting. He would further say that he could claim no personal credit for either the planning or execution of that piece of work. He saw it when it was completed, and asked Mr. Bond to allow him to bring it before the Society. The patient, some ten or eleven years ago, was run over in Glasgow, and, according to his account, the practitioner who attended him did not treat the case properly, with the result that he lost the bridge of the nose. He was afterwards operated on by Dr. Heron Watson, in Edinburgh, who removed finally the whole of the external and internal parts of the nose and also enlarged a large perforation of the palate. Until quite recently the patient wore an arrangement consisting of a nose fixed to a pair of spectacles, which was, of course, very inconvenient, seeing that the spectacles could not be cleaned without the nose being removed. A short time ago

the patient suggested to Mr. Bond that possibly the nose could be attached to the plate which he was wearing, covering the perforation of the palate, and Mr. Bond, acting on that suggestion, designed the piece of work now exhibited, and which had been very successful. There was a gold tube passing from the centre of the plate through the opening. The nose had a strong gold pin with a short bar on it, which ran into a slot in the tube. It was put on slightly sideways, and then being twisted straight, enough pressure was exerted to make it fit tightly. The patient had his own ideas about these matters, and experimented a good deal himself in the way of trying to bend the tube and colour the nose, but the results were not always satisfactory to the operator.

On the Origin of the Mammalian Teeth.

By H. W. Marett Tims, M.D., F.Z.S.

Lecturer on Biology and Comparative Anatomy, Westminster Hospital Medical School.

Mr. President and Gentlemen,—Allow me at the commencement to offer my apologies to this Society for presuming to read a paper on a subject so particularly its own, and with my apologies may I tender my sincere thanks.

The subject which I propose to bring before you to-night is the origin of the mammalian teeth, together with a brief outline of some of the more important views connected with it. It is a subject not only of great interest in itself, but also of great importance from both classificatory and phylogenetic points of view.

Since the epoch-making works of Darwin, a vast amount of research has been carried on with the object of tracing out the evolution of almost every organ of the animal body, but curiously enough the teeth have not, until comparatively recently, received the amount of detailed attention that might have been expected. This is the more remarkable when we remember how impor-

tant palæontology is in filling up the gaps in ancestral history, and that the teeth, the hardest structures in the animal body, are consequently *the* organs most likely to be preserved in geological records; indeed, in many instances they alone remain.

Another point adds interest to the study of teeth, namely, the modifications which they undergo in relation to the special kind of food adopted by the animal, and, therefore, the light they throw upon the natural history of their possessors.

Among the elasmobranch fishes, the surface of the skin of the body is covered with dermal denticles, structures having the characters of ordinary teeth. They were formerly of considerable size and served for protection. In other fishes they have become modified into the ordinary fish scales.

The lining membrane of the mouth is derived from the same embryonic layer as the epidermis, and teeth develop here also. In this latter situation they become more pronounced owing to the greater use made of them in seizing and eating prey.

In the teleostean fishes all the bones of the mouth, as well as those of the hyoidean and branchial arches may bear teeth. Among the higher vertebrates, their position becomes more

limited and ultimately they are confined to the pre-maxilla, the maxilla and the mandible. In these situations they may be found upon the inner side as well as upon the free edges of the bones, and as the latter become worn down, fresh ones take their place, thus giving rise to the so-called polyphyodont condition.

Among the reptilia, the teeth of the lower jaw are in some cases fused to a kind of ledge on its inner side, a condition known as pleurodont; in others they are situated at the free edge of the jaw, when they are said to be acrodont. In the crocodilia, the thecodont condition obtains, that is, the teeth are embedded in alveoli, thus adding to their firmness.

As a rule the dentition of the reptilia is homodont, but in Hatteria and some extinct forms of the American trias a heterodont condition is found, that is, the teeth are differentiated into incisiform, caniniform and molariform. This differentiation attains its maximum only among the mammalia, in which also another very important structure is added to the teeth, the cingulum.

From the time of Cuvier the number and character of the mammalian teeth in the dried skull have been noted, but an important advance was made by Owen, who introduced the terms monophyodont, that is animals with a single set of teeth, and diphyodont or those with two sets,

milk and permanent, or deciduous and successional. Among the former were placed the Marsupials, the Edentates and the Cetacea.

Accepting the primary division of Owen, a difficulty at once arose in connection with the Marsupials. It is generally believed that the ancestors of the mammalia were the theromorph reptiles, and these are known to have been polyphyodont. The Marsupials are regarded by many as being among the lowest in the mammalian series and in the direct line of ancestry. The anomaly at once becomes apparent, the polyphyodont reptilia giving rise to the monophyodont marsupials, and these in turn succeeded by the diphyodont mammalia.

This was a matter of great difficulty, and gave rise to a further question. If the Marsupials have only one set of teeth and the higher mammalia two, which was the super-added set, the milk or the permanent?

As I have said, the Marsupials, Cetacea and Edentates were regarded as monophyodont, but in 1869 Sir William Flower (1) showed that in the nine-banded Armadillo and in one or two other Edentates, of the eight teeth habitually present on each side of the jaw, all except the most posterior are preceded by milk teeth which are only shed at the time of almost full development of the animal, and consequently had escaped

previous observation. From this and other discoveries it is to be seen that the Edentates can no longer be classed as monophyodont.

Before dealing with the Cetacea and Marsupials, I would refer to another point.

Evidence has been brought forward in support of views that two other dentitions are represented amongst the mammalia, a pre-milk and a post-permanent dentition. The evidence in favour of the existence of the latter is, I think, now beyond doubt. Lecke (2) and Kükenthal (3) have observed such traces in the Seal, Röse (4) in Man, M. F. Woodward (5) in Erinaceus, and I have noted its existence in the Dog (6).

The evidence in favour of the pre-milk dentition is, however, I think, insufficient. It rests upon the discovery by Lecke (7) of tooth rudiments on the labial side of the functional teeth in certain marsupials. The existence of these rudiments is not disputed; they have been verified by M. F. Woodward (8), in Myrmecobius, Phascologale and Dasyurus, but Lecke's interpretation of these rudiments depends entirely upon the question as to whether the single functional set of teeth in marsupials is in reality the milk set. It is well known that in these animals only one tooth, $pm.^4$ is replaced, the deciduous tooth being molariform in character. Kükenthal (9) discovered tooth rudiments on the lingual side of

the functional teeth in certain marsupials, which he regarded as representing the successional teeth, and the functional set as corresponding with those known as the milk teeth, consequently Lecke has regarded the rudiments on the labial side of these as representing a pre-milk dentition.

As far as I am aware, there is no instance of four dentitions being present in any one part of the jaw of any animal,[1] and, as I have shown, there is undoubted evidence of the existence of the representative of a post-permanent dentition. Consequently, since the appearances are the same, I would regard the three dentitions of the marsupials as homologous with the three dentitions of the hedgehog, dog and man. If this be so, then Lecke's pre-milk dentition no longer exists, but what he interprets as such appears as the vestigial remains of the milk dentition,

[1] From abstracts of Professor Lecke's paper, which appear in the Journal of the Royal Microscopical Society for February, 1896, it would seem that all four dentitions are present in Erinaceus. This is, I believe, an error, as M. F. Woodward (5) has made no mention of the existence of more than three dentitions. Moreover, the interpretation which Lecke first put upon them was that they represented the pre-milk, milk and permanent dentitions; now, however, I believe that he agrees with Woodward in regarding them as the milk, permanent and post-permanent. It is this change of opinion which may have caused the translator to make this statement.

and the functional set as homologous with the permanent dentition, thus once more returning to the view long ago held by Sir Wm. Flower and Mr. Oldfield Thomas.

From what I have said it will be seen that the marsupials are no longer to be regarded as truly monophyodont though the term is sometimes still used, but as indicating that one set of teeth alone is *functional*.

In the Odontoceti, Kükenthal (10) has proved the existence of tooth rudiments on the lingual side of the single functional set of teeth, and interpreting the condition in the same way he regards these whales as having a persistent milk dentition. I should prefer to regard them as representing the permanent set with the post-permanent representatives, the milk teeth having disappeared. From this point of view the whole series are brought into uniformity.

It is interesting to notice that Lecke (11) has recently, if I understand him aright, expressed the same opinion with regard to the dentition of the whales, noting that in other cases of monophyodontism it is the first dentition which disappears, by which, I presume, the milk dentition is intended. I would, therefore ask, upon what grounds are the Marsupials to be excepted? if the teeth of the Odontoceti do not belong to the milk series, then why should those of the Mar-

supials? The validity of the evidence in favour of the existence of the pre-milk rudiments rests upon a satisfactory answer to this question.

From what has been said, certain conclusions may, I think, be drawn :—

(1) That there is not sufficient evidence to warrant the belief in the existence of a pre-milk dentition.

(2) That the dentitions are tending to disappear from without inwards. This is in agreement with a conclusion of Wiedersheim (13), who adduces facts which indicate that a "gradual reduction of the milk dentition is taking place."

(3) That there is ample evidence in favour of the existence of three dentitions, the deciduous, successional and post-permanent; thus bringing the mammalia more into line with their polyphyodont reptilian ancestors, and doing away with the former difficulty as to whether the milk or the permanent is the super-added dentition, since both are of equal antiquity handed down from our reptilian progenitors.

Turning next to the molars and first premolar, which, as a rule, are represented in one dentition only, the question arises to which dentition do they belong? Beginning with pm.[1] which is replaced in a few animals only, such as the Indian tapir (14), Hyrax (15), in some cases the rhinoceros (16) and Pig (17) and the extinct

Palæotherium (16). In the Dog it is not replaced, and is occasionally absent altogether. In a section through this region in the Dog, three down-growths of the dental lamina are to be seen, and it is from the central one of these that this tooth develops. Now it has been said that the deciduous, permanent and post-permanent dentitions are represented in this animal, consequently I think that the single pm.^{1} of the dog is to be regarded as belonging to the permanent series. For the same reason I believe the molar teeth are to be regarded as belonging to the same series. I would here like to refer to a curious point in the dog's dentition. As is well known, the highly specialised sectorial tooth replaces a tooth molariform in character, a condition somewhat similar to that which I have referred to as occurring in the Marsupials. For the same reasons as given above in connection with pm.^{1} I regard this deciduous tooth as belonging to the so-called permanent series; its successor (pm.^{4}) developing on the lingual side and quite independently of the tooth which it replaces.

Having thus seen that the mammalia are brought into line with the reptilia as regards the number of the dentitions represented, I will next refer to the views that have been held with regard to the origin of the complex crowns of the cheek teeth from the simple reptilian cone.

First let me refer to the tritubercular theory which is very widely accepted, especially in America. This view was advanced and has been strongly upheld by Professors Cope and Osborne, the latter again putting it forward in an address on the History of the Cusps of the Human Molar Teeth, delivered before the New York Institute of Stomatology, April 19, 1895.[1]

The evidence in favour of this view is mainly palæontological. Beginning with the simple haplodont cone of the reptiles, the next form is that found in the triassic rocks in Dromotherium. Here, in addition to the main cone, there is a minute cusp on both the anterior and posterior slopes. These cusps are said to be of mechanical origin and formed at the point of contact of the teeth of the upper and lower jaws as they interlock. By the increase in size of these two cusps the triconodont form, as found in Amphilestes is produced; here there are three nearly equal sized cusps in the same antero-posterior line. Owing to the wedging action brought about by the closure of the jaws the main central cusp, the Protocone of the upper jaw is driven inwards and in the lower jaw, where it is called the Protoconid, is driven outwards, the three cusps

[1] This address was reprinted in the *Journal of the British Dental Association* of October 15, 1895, and in the *Dental Record* of August of the same year.

forming a triangle with the apex inwards in the upper jaw and outwards in the lower. The anterior of the two cusps at the base of the triangle being called the Paracone in the upper and Paraconid in the lower jaw; the posterior cusp, the Metacone and Metaconid respectively. Such a form of tooth is called a tritubercular tooth and is found in Spalacotherium. The remaining cusps are secondarily superadded to these, but it is not necessary to enter into any detail concerning them. Such tritubercular teeth are said to be found among some of the existing insectivora and lemurs.

From this it will be seen that the Protocone and Protoconid represent the primitive reptilian cone. Such being so, we should expect them to develop first in the embryonic history of any tooth, if Ontogeny does recapitulate phylogeny.

In the paper above referred to Professor Osborne admits that it does, for he says "we should expect in the embryonic jaw that the calcification of the tooth germ would be very significant, because we know that the embryonic structures in their development follow the order of addition or evolution." Now this development has already been worked out by Röse (18) in the Marsupials and Primates, and by Tæcker (19) in the Ungulates with these results. In the lower jaw the Protoconid does develop first.

With regard to the Paraconid and Metaconid which should be of equal importance, and secondary only to the Protoconid, the Paraconid develops second in the Marsupials only, while in the Primates and Ungulates it is absent altogether, and the Metaconid in the Marsupials does not develop until after the Hypoconid and Entoconid. Taking these three orders together, even the lower jaw does not lend much support to this view. But in this paper Professor Osborne says, "in the lower molar teeth" (he is dealing with the Primates only) "the order of calcification is precisely the order of evolution."

It is, however, in the upper jaw that still stronger evidence against this theory is to be found, for in not one of the three orders does the all important Protocone develop first. It is the Paracone in every instance, while in the Ungulates the Metacone also develops before the Protocone. Professor Osborne goes on to say, in speaking of the lower jaw, "so we find the order of embryonic development exactly repeats the order of historical development, and in every way presents the strongest kind of confirmation of the theory of cusp formation." The upper jaw, which presents the most damaging evidence, he dismisses with the single sentence, "but this, you see, is not exactly the case in the upper molars."

I would here like to draw attention to an error

in the usual description of the first upper milk molar in the human subject, an error which is of some consequence in its bearing upon this question. In all the books on Human Anatomy that I have consulted, in which a description of the individual milk teeth is given, it is stated that the first upper molar consists of three cusps only, two placed externally and one internally. From such a description one would conclude that we have here a typical tritubercular tooth, a tooth that would in every way fit in with Professor Osborne's views; but of the specimens that I have had an opportunity of examining, in no single instance do I find such a description to hold good.

If the tooth be removed from the jaw about the time of birth, I think it is possible to recognise eight cusps some of very small size, but leaving these out of consideration, as possibly disappearing with use, I fail to notice two external cusps. There is one main cusp externally with a minute cusp at the anterior end of it, and another at the posterior. This latter is rather bigger in some specimens than in others, but in no way to be compared in size with the main cusp, sufficient to warrant the description given. This point is referred to by M. Topinard (20) in his paper on the "Evolution of the Molars and Pre-molars in the Primates," who likens the

external border of this tooth to a "fleur de lys," and adds that this circumstance has so struck M. Sappey that he describes this tooth as having three external cusps.

Before closing, there is one other theory that must be referred to; it is that known as the multi-tuberculate theory, which was put forward by Dr. Forsyth Major (21) and supported by E. S. Goodrich (22) and others. According to this view the early mammalia were thought to have had teeth possessing many cusps, and that by a gradual suppression of some of these, the teeth of existing mammals have been derived. Two pieces of evidence are in favour of this theory (i.) quite early fossil forms, such as Tritylodon, have been found with multi-cuspidate teeth; and (ii.) that the Monotremes, among the most primitive of existing mammals, have teeth of the same description.

With regard to the fossil forms, I think, however, it should be borne in mind that their dental formulæ tend to show, by the absence of the canines and the reduction in the number of incisor teeth, that they were probably highly specialised forms. That some of the mammalia may have been derived from the multituberculata is, I think, possible, but that they have all been, is, I think, highly improbable.

With regard to the origin of the multitubercu-

lata from the reptilia, a possible explanation is to be found in Kükenthal's concrescence theory. By this a fusion of several teeth of the same dentition and of different dentitions is supposed to have taken place, causing a reduction in the number of teeth; the nine cusps in the teeth of Tritylodon being due to the fusion of three teeth and of three dentitions. Time does not permit of my entering into the evidence which has been adduced in favour of these views, I have merely endeavoured to bring before you some of the more important facts concerning the evolution of the mammalian teeth.

May I, in conclusion, once more thank this Society for their great kindness in receiving this paper; and in doing so I would express my great indebtedness to Mr. Charters White, whose knowledge and skill in all matters relating to scientific photo-micrography are so well known, for the great trouble he has taken in photographing the sections and preparing them for the lantern. I fear I shall have wearied you with too much detail, but I venture to hope that in placing before you some of the more important views in relation to mammalian tooth genesis, the time spent may not have been altogether unprofitable.

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Discussion.

Mr. F. J. Bennett: I do not rise for the purpose of general criticism at this late hour, but I should like to add a little to the questions raised in the paper. As far as I understand it, what the author would like us to say is chiefly how far our own experience and knowledge will bear out or add to the sum of knowledge which already we possess. We may possibly come across cases throwing side light upon these questions. A great deal of the subject matter of this paper is fairly familiar to us from the papers of Osborne and Woodward, which have appeared in our journals, and we have also been kept fairly familiar with it by our text books. In a short paper I read before the British Dental Association some time ago, I tried to bring together what little information there was to prove that there were really traces of teeth underneath what we call our permanent molars, and ventured to express the opinion that those observers who said that these three molars belonged to the temporary series had substantial grounds for believing so, owing partly to the strong similarity between the pattern of the first and second temporary molars, and the first, second and third permanent molars. The similarity between these is astonishing. Cusp for cusp and ridge for ridge may be matched between the second temporary molar and the first permanent molar; whereas if we take the second bicuspid and match that with the first permanent molar, there is not the faintest resemblance. That might at least rouse our suspicions in the matter, but when we come to collect evidence, we find there is really evidence of epithelial structures underneath and surrounding the permanent molar teeth, which lead one to suppose that they are either aborted enamel germs or something of

that nature. Mr. Eve brought forward a paper describing this, and Malassez has also discovered in the substance of the periosteum epithelial structures. I fancy that the enamel nodules afford almost as good evidence as any to be obtained, as showing that there are really germs of a later series underneath these three teeth. We have not only here a diminutive tooth attached to the substance of the tooth above it, but we have actually the enamel string or gubernaculum. I consider that this evidence, taken with that of Mr. Eve and others, is really very great in this direction; at the same time I am quite aware that there may appear staggering objections to this view, and that very often the enamel string is found attached to the buccal surface of the tooth, and therefore it might be argued by those who wish to assume a pre-milk dentition that these really are the analogues of the pre-milk dentition. That may possibly be so, but on looking at some specimens I find that nearly as many are found arising between the palatine and anterior buccal, or between the posterior buccal and palatine fang, coming down by a string attached to this position.

Mr. Arthur Smith Woodward: I have listened, Sir, with great interest to Dr. Tims' paper, but regret I can only speak of the latter part from personal knowledge. For several years I have had the privilege of studying the vertebrate fossils in the British Museum, and the facts of palæontology suggest several interesting points in connection with the problem which Dr. Tims has brought before us. It seems to me that in solving these very broad questions we ought to turn first to those groups of organisms in which they find their simplest expression. Hence I have long been much interested in examining the teeth of extinct fishes, whose skeletons naturally occur in great abundance in almost all water-formed rocks, from the date of their earliest appearance up to the present day. The evidence they afford as to the modes of complication of teeth and the evolution of order from chaos, is worth noting. When we study the earliest sharks we perceive most distinctly that the complicated teeth of these fishes are often due to the

fusion of originally separate cusps, each little cusp having been formed round its own pulp and primitively free from all surrounding cusps. One family of upper Palæozoic sharks, that of the Cochliodontidæ, exhibits the fusion into plates not only of adjoining teeth of one series, but also of successional teeth of several series. It is thus clear that tooth-complication does actually take place among the lower vertebrates by the fusion of cusps belonging to one series, and also by the fusion of cusps belonging to more than one series. On the other hand, there is equally clear proof among fossil sharks that tooth-complication sometimes happens by another method, namely, the multiplication of cusps by some organic process which we do not yet understand. In the Notidanidæ, for example, which have saw-shaped teeth, the Jurassic species never exhibit more than about five tooth cusps, those of the Cretaceous period often have seven cusps, while those of the latest period before the present, namely, the Pliocene, exhibit the most complicated teeth, sometimes with no less than ten or eleven cusps. It is quite certain that in this case the evolution results from the multiplication of cusps. With reference to the gradual acquisition of a regular arrangement of the dental armature, it is interesting to examine the mesozoic ganoid fishes of the family Pycnodontidæ. These have a pavement of grinding teeth, and whereas this pavement is very irregular in the earlier members of the family (*e.g.*, Mesodon) it is reduced to a few comparatively regular longitudinal series of teeth in the latest members (*e.g.*, Cœlodus).

Such being the facts in regard to fishes, there is no improbability in any of the theories of tooth-complication propounded by embryologists who have studied the mammalian dentition. Palæontology, however, as yet throws no certain light on the subject. It does not even afford any information concerning the supplementary successional teeth of which rudiments are claimed to occur in several existing mammals. The reptiles with teeth presenting most superficial resemblance to those of mammals, the Theriodontia, occur only in Permian and Triassic strata, and

practically nothing is known of the mode of succession of their teeth. The so-called Triassic mammal, Tritylodon, is now almost certainly proved to be one of them. At the end of the Triassic period, so far as known, the Theriodonts and their allies all suddenly disappear, both in South Africa, Europe and America, and when undoubted mammalian jaws are first found (Stonesfield slate and Purbeck beds) they cannot be distinguished from those of modern marsupials. In fact, the evidence of palæontology in regard to the evolution of the teeth of the mammalia is very disappointing. Even the "tritubercular theory" to which Dr. Tims has referred with some well-merited criticism, has a much more insecure palæontological basis than most of its supporters and exponents claim for it.

Mr. W. A. Maggs: We are much indebted to Dr. Tims for his able paper, and for bringing before us the different views held as to the origin of mammalian teeth. It seems to me the multituberculate theory has some *primâ facie* evidence to support it; that is to say, in the earliest mammalian fossil teeth, represented by the Mesozoic or Secondary period, the types correspond with the diprotodont, or polyprotodont marsupials—either with tuberculate molars, like the phalangers and kangaroos, or with triconodont molars, as in the carnivorous marsupials—Dasyuridæ. It is quite possible that these animals, if they are not Prototherian, have not progressed in the zoological scale at all, and that they are the marsupials, or would be the marsupials if they existed, of the present time. Then, as Mr. Woodward has just mentioned, there is a gap in the geological records, and we come across no new tooth forms until we get to the Tertiary period, with Eutherian mammals, in which the trituberculate molar is found to predominate, and here we have a form of molar like that seen in some of the Carnivora, Insectivora and Lemuridæ of the present day. The homology of the particular cusps is rather doubtful in all orders of mammals. It is difficult to say how the multicuspid teeth were formed, whether by fusion of separate conical teeth, owing to a more limited succession, or by what other means. Dr. Tims gets rid of

the pre-milk dentition, which is satisfactory in one way, in that it simplifies the ground a little. I am not at all sure about the correct interpretation of the tooth change in marsupials. When a dentition like that of the opossum or the Macropodidæ, or any of those animals with a large number of teeth, is said to belong to the milk set, it is giving a formula for the milk dentition to which there is nothing at all comparable in Eutherian mammals. The usual deciduous dentition is, of course, very much smaller, di $\frac{3}{3}$ dc $\frac{1}{1}$ dm $\frac{3-4}{3-4}$. I do not know whether that is a sound argument against it, but it is going from one extreme to the other; the other extreme being to say that those marsupials which had any milk dentition had simply one molar on each side, above and below. Dr. Tims did not mention the development of the deciduous teeth from the epithelial band before the permanent teeth, and, therefore, being arrived at necessarily before the permanent successors, but that is one reason for supposing that if one set of teeth is developed only, it should belong to the deciduous dentition. It has been shown that all mammals have a diphyodont dentition, even the Cetacea and Edentata, but it is not always the same dentition which persists. Dr. Tims showed on the screen some tooth germ in the premaxillary region of a dog. I should like to know whether he has seen this epithelial lamina, which he believes to indicate a third dentition, going all round the jaws, because it is quite possible it may be an abnormality—an abortive tooth germ in this situation, or the origin of a supernumerary tooth. The so-called first pre-molar of the pig is interesting. This tooth is erupted early, has no predecessor, is lost early, and it has always been a debatable point as to whether it belongs to the deciduous or permanent set. Owen and Flower placed it in the former category. I am glad to hear Dr. Tims say there is a successional tooth to this one, so that it probably belongs to the deciduous set, as has been stated by Lesbre.

Mr. W. B. Paterson: I should like to supplement the question that Mr. Maggs has put with regard to the dentition of the dog, and in doing so I would revert to the

photogragh No. 2, placed on the screen. In that specimen of the developing dentition of a dog, we were shown three teeth in process of formation from the same epithelial downgrowth, viz., the deciduous tooth, the permanent tooth, and a third tooth germ. Mr. Maggs has asked whether that triple arrangement is found generally, or only occasionally, in jaws. I would like to supplement that by asking, does Dr. Tims find that triple arrangement of tooth germs constant in the dog, to which he has devoted some special attention, or is it an occasional occurrence, such as Mr. Maggs has referred to, and which might be described as a supernumerary tooth? Has Dr. Tims examined the skulls of dogs and found in them the calcified germs of a third set, or taking the region he has shown on the screen, viz., that of the third incisor, has he ever found any constancy in the nature of a fourth incisor?

Mr. Baldwin: Dr. Tims has asked whether in our experience we have ever met with any evidence of a third set of teeth in the human subject. Judging from my own experience and from enquiry of other members, and from the proceedings of the Dental Societies, I should say unhesitatingly that there is no such thing, and that there has never been any real scientific evidence of a third set of teeth, or even a partial third set of teeth in the human subject. Frequently it has been said that a third set of teeth has been noticed, but when people with knowledge have examined those cases they have always been found to be cases of the wisdom teeth, or other teeth of the permanent series, which had remained buried throughout the greater part of life, and then erupted late. For instance, I have a case under observation at the present time of a lady 70 years of age, who is just cutting her wisdom teeth. There is one other point I would like to speak upon, and that is that we sometimes, indeed, rather frequently, find supernumerary teeth in the molar region. These have always been a difficulty to my mind, because what do they represent? How do they arise? It would seem from what we have learnt from Dr. Tims's paper that they might be representatives of a third set, the post-permanent set of teeth.

Dr. Marett Tims, in reply, said: Mr. Bennett has referred to the occasional occurrence of enamel nodules as affording additional evidence in favour of the existence of additional tooth rudiments in the molar region. Regarding, as I do, the molar teeth as belonging to the permanent series, I should consider these enamel nodules as being calcifications of the dental lamina representing the post-permanent dentition, and which may occasionally give rise to a fully formed tooth.

Mr. Woodward spoke of the fusion of the cusps in fishes. This fusion is extremely interesting in itself, but I do not know that it throws much light on the origin of the mammalian cusps, for if the mammalia have sprung from reptiles with haplodont teeth, any cusp fusion that may have taken place in the fishes must be altogether independent. I quite agree with Mr. Woodward's remarks about the tritubercular theory; the formation of the cusps and their subsequent rotation reads very nicely and simply, but we have no evidence of any such rotation having taken place.

Some of the speakers were decidedly in favour of the multituberculate theory. Though this may afford an explanation of the origin of the teeth in some forms, I do not think it can be held for every form. It is not borne out by embryological evidence in the dog, or any of those animals at which Röse and Tæcker have worked. Instead of finding numerous cusps in an early fœtal condition, we find the earlier the stage, the simpler the tooth. It begins with a single cone from which others arise. I have already mentioned, too, the specialised dental formula of the multituberculata.

There is one structure to which, I think, perhaps sufficient importance has not been attached in connection with cusp formation, namely, the cingulum.

Mr. Maggs has mistaken my remarks on the marsupial teeth. I regard Lecke's pre-milk dentition as vestigial milk teeth, and the functional teeth of the marsupials as the permanent teeth; thus, once more returning to the view long ago held by Sir William Flower and Mr. Oldfield Thomas, but abandoned since Kükenthal's discovery of

tooth rudiments on the lingual side of the functional teeth. In the same way I would regard the functional teeth of the odontoceti as permanent teeth with their post-permanent lingual rudiments.

I have not found evidence of the three dentitions in all regions of the jaw, only in the incisor, canine, and anterior pre-molar region, most marked in the outer incisor, that is, in the very regions in which Lecke describes his pre-milk dentition.

The first pre-molar, like the molars, I regard as belonging to the permanent series. In the dog this tooth seems to be undergoing suppression, and is occasionally absent altogether, but as serial sections were made of jaws at various ages, and the teeth identified, I have no reason to doubt that the tooth which I have described as the first pre-molar is so in reality. Though I have seen variations in the number of pre-molars in the dog, I have not seen any variation in the number of incisors.

The PRESIDENT tendered the thanks of the Society to Dr. Marett Tims for his paper, and to those members who had brought forward Casual Communications.

Odontological Society of Great Britain.

ORDINARY MONTHLY MEETING

April 13, 1896.

MR. DAVID HEPBURN, L.D.S.Eng.

PRESIDENT, IN THE CHAIR.

THE SECRETARY read the Minutes of the last meeting, which were confirmed.

The following nomination is before the Council of the Society :—ROBERT STEPHEN FAIRBANK, M.R.C.S.Eng., L.S.A.Lond., 18, George Street, Hanover Square, W.

The following gentleman having signed the required obligation form, was admitted a member of the Society :—HAROLD DEWE MATTHEWS, Grove Field Villa, Cheltenham.

The following gentleman having signed the obligation book, was admitted to membership of the Society by the President :—E. L. DUDLEY, L.D.S.Eng.

The following gentleman was proposed as a non-resident member of the Society :—CHARLES SYDNEY PRIDEAUX, L.D.S.Eng.

The following gentlemen were elected non-resident members of the Society :—GEORGE HENRY BOWDEN, L.D.S.Eng. and Glasg., Roseneath, Reigate, Surrey; T. RUBERRY CHAMBERS, L.D.S.Eng., New Inn Hall Street, Oxford.

The LIBRARIAN reported the receipt of *The Annual Report of the Smithsonian Institution*, July, 1893, and "The

Jack Rabbits of the United States," in addition to the usual periodicals and exchanges.

[The LIBRARIAN will be glad if members will kindly inform him of any changes of addresses, or additional qualifications, so that the new List of Members, to be published after the annual meeting, may be as accurate as possible.]

The CURATOR: I have here, sir, two specimens of old bone work presented by Mr. W. F. Forsyth. One is a very beautiful example of the insertion of natural teeth in front of the case. In the other specimen, instead of natural teeth, tube teeth are inserted, and two pins at the sides show that swivels had been used.

Mr. Forsyth has also presented an ancient instrument for the extraction of teeth. It looks, at first, a very clumsy piece of work, but on careful examination it will be seen that it is a very ingeniously constructed piece of mechanism. By closing the handles the buccal blade of the forceps is driven forward for a certain distance, and firmly grasps the tooth, but not to such an extent as to close up entirely and crush it. After the blades are sufficiently closed they are bodily raised and the tooth drawn out of its socket. It is therefore an instrument which might be really described as one for "pulling teeth," because it does actually pull the tooth out of its socket.

Mr. J. Henry Whatford, of Eastbourne, has sent an interesting model showing a large mass between the left upper central and the lateral. On first examination one is a little puzzled to know exactly what is being looked at, but I think we may decide that this is a gemmated mass between the normal left central incisor and the normal left lateral.

Mr. CHARLES A. CLARK presented a skiagraph taken of a second lower molar by means of the new x rays. It would be seen that the roots were shown, and that the pulp was fairly well indicated. It was taken by putting the sensitive plate in the mouth carefully covered with black paper to protect it from ordinary light, and wrapped in a sheet of rubber dam to protect it from moisture. The bulb was held close against the tooth, and the exposure was four minutes.

A Case of Aneurism by Anastomosis involving the Vessels of the Hard Palate.

By A. Marmaduke Sheild, M.B., F.R.C.S.

On the afternoon of Saturday, January 18, I was requested by Dr. Norton, of Queen Anne's Mansions, to see immediately a gentleman, whose condition was stated to be serious on account of persistent bleeding of an arterial character into the mouth. He was a retired officer, aged 57, and had suffered from "liver affections" but never from malaria. In 1893 he had an accidental fall "and broke his nose," and repeatedly has suffered from severe epistaxis, referred to the congested condition of his liver. On January 15 bleeding occurred into the mouth, and he lost about half a pint of bright blood. On January 16 the bleeding occurred again, and he lost two tablespoonfuls. On the 17th the bleeding again occurred to a considerable amount, and he noticed that the blood issued forth in jets into the mouth. On the 18th the same occurred. Dr. Norton saw him on the 16th, and noticed an ulcer the size of a threepenny piece on the left side of the hard palate, about opposite the second molar tooth and close to the alveolus. Arterial blood was spurting in a jet from the centre of this, and the patient was losing a quantity of blood, his mouth being filled with clot. Dr. Norton temporarily arrested the bleeding by pressure and perchloride of iron, but it always recurred.

When I saw him on the Saturday evening I noticed that he was pale and exsanguine, with a very weak pulse. The mucous membrane of the roof of the mouth was discoloured by the iron application, and a little clot could be seen on the base of a small superficial ulcer situated opposite the same molar tooth on the left side close to the alveolus. I feared to disturb this, and made a very gentle examination. I soon found that a pulsatile swelling the size of a filbert occupied the tissues at the base of the alveolar process. Its margins were not defined, but faded away imperceptibly. The pulsations were strong, so as to lift the examining finger, and felt exactly like those of an

aneurism. There was one large pulsating vessel posteriorly, and this I could compress, but without altering the pulsation of the tumour. The teeth were quite sound, and the morbid swelling, whatever its nature, terminated abruptly at the base of the gums. The ulcer was quite superficial, and devoid of any induration or distinct margins; it looked like an accidental abrasion from hot food or a piece of bone. The patient was quite unable to give an exact account of the length of time the swelling had existed, and it seemed to me he had hardly much noticed its presence. There was nothing to be seen on inspection of the nares, and there was no bulging of the palate generally to indicate a protruding antral tumour. I directed that a nurse should be employed, with instructions to press upon the spot with a minute sponge soaked in turpentine, or with the finger, should bleeding recur. On reflecting upon the symptoms of this very unusual case, I was rather inclined to look upon it as an example of pulsating sarcomatous disease of the hard palate, yet the bone was not obviously expanded, and the pulsations were far more forcible than I have ever seen in several examples of this disease in the bones of the skull and the femur, ilium and tibia. The supposition of a definite aneurism of one of the palatine vessels also entered my mind, but I rejected it on account of the rarity of such a malady, and the rather diffuse outlines of the tumour.

Seeing the inevitable uncertainty of an exact diagnosis, the great hazard of cutting into, or cauterising the growth, and the desirability of definitely stopping the bleeding by some proceeding which would be sure and certain, I advised that a portion of the maxilla should be removed, so as to ensure complete extirpation of the growth. The patient, who showed great sense and courage in his trying and dangerous position, at once acceded to what I thought best for his relief.

The operation was performed on Monday morning, January 20. Dr. Hewitt gave the anæsthetic, and Mr. Arthur Ward and Dr. Norton assisted me. The details of the operation are of no great consequence; it was performed with saw

and cutting bone forceps, the lip and side of the nose being incised, and the tissues reflected. There was no unusual bleeding. A portion of the upper jaw was removed, comprising the whole alveolar margin from the second incisor tooth, and the hard palate as far as the middle line. The posterior palatine artery spirted persistently, and was only restrained by plugging the canal with a spicule of wood. I would, however, draw special attention to the advantages of the lateral posture in all these operations, with the head well hanging over the edge of the table. Dr. Hewitt and myself have drawn attention in detail to its value in a recent paper published in the *Transactions of the Medico-Chirurgical Society*. After-oozing was checked by the application of a turpentine sponge, and a small sponge soaked in the same material was left in the cavity. The after-treatment of the case was left entirely in the hands of Dr. Norton, and recovery was uneventful. About two hours after the operation some more oozing came on, which was checked by full doses of ergot, and placing the feet in hot water. There was some little trouble in removing the turpentine sponge, as it clotted the blood and was firmly wedged. The horse-hair sutures were removed in a week, and union of the lip was proved firm and good, the cicatrix scarcely showing. All this time the mouth had constantly been kept flushed with benzoin and chlorinated soda mouth washes.

The highly vascular nature of the tumour was apparent after removal of the portion of bone, for it subsided and contracted, so that what was once a prominent pulsating mass was now only a thickened flattened area of sponge-like tissue, with a small superficial ulcer in the centre. My colleague, Dr. Rolleston, examined the tissue microscopically, and his report fully bears out the appearances observed during life of hæmorrhage and free pulsation:—

"A section taken through the growth and ulcer down to the bone showed that underlying the granulation tissue, which was somewhat scanty, there were numerous blood vessels. The arteries were well formed and numerous; one or two showed slight endarteritis obliterans; there were a

few large spaces lined with endothelium, and with but thin wall, probably dilated veins. All the blood channels seen, therefore, had proper walls, and there was no extravasation of blood into the tissues, and no pigmentation to suggest that any past extravasation had occurred. There was nothing to suggest sarcoma or epithelioma. From the small amount of organising granulation tissue, and from the absence of signs indicating irritation of the adjacent mucosa, it appears probable that the ulcer is of very recent date."

So far as I have been able to ascertain these cases are exceedingly rare. They do not receive mention in the leading text-books in the articles on tumours of the jaws, and the only reference I have been able to find of anything of the kind is by the late Mr. Salter. Writing in Holmes' "System of Surgery" this authority proceeds as follows:—"The tissues about the necks of the teeth are obnoxious to the growth of vascular tumours, which vary from passive *nævus-like* swellings to those other forms of more arterial character—*aneurisms by anastomosis*. I have met with both forms of the disease."

Further on in the article Mr. Salter refers to a case somewhat resembling the one I have related, but differing from it in the very important particular that the tumour was pedunculated and attached to the alveolar margin, yet I will ask the Society to note (1) how recurrent bleedings occurred from too incomplete attempts at removal, and (2) that the phenomena of pulsation was not observed.

"A rather severe instance," writes Salter, "which occurred recently under my care manifested itself in the region that should have been occupied by the left lateral incisor of the upper jaw; but as the laterals were wanting in this person, the tumour formed between the canine and central incisor. It had been about six months in reaching its then size, the dimensions of a large marble flattened on the surface. It was of a purplish colour, streaked with many vessels on the surface; it was easily compressed, but was elastic, and when pressed it became pale, exsanguine, and much reduced in size; upon removing the pressure it resumed its previous

aspect in a pulse or two. The surface of the growth was tolerably smooth, the base somewhat constricted, being about one-third less than the head of the tumour. The whole of the gums were very red, turgid, and swollen, and the little tongues of gum between the necks of the teeth generally were enlarged and spongy. The patient had suffered no pain, but was conscious of a constant throbbing and pulsation. The most important symptom, however, was the hæmorrhage, which had latterly become a serious source of trouble and distress; it usually occurred at night; it would ooze from the mouth and stain the pillow and sheets, and sometimes trickle into the glottis and cause momentary suffocation."

"The treatment which I first adopted in this case was determined by the very *arterial* character of the tumour. I attempted to destroy it by ligature; a needle armed with a double thread was passed through its base, and each portion of the thread was tied so as to strangulate half of its attachment. The ligatures were tied tight, but did not cut through the substance of the growth. Their effect was for the time to produce complete strangulation; the tumour was tense, and the blood could not be squeezed out of it by pressure. This plan did not ultimately succeed, for the size was not permanently diminished and the circulation was re-established. I next removed the tumour by a very tight ligature, cutting it clean off; after this it returned as before, and I finally extirpated it with a scalpel, cutting freely inwards so as to remove a portion of the spongy vascular bone which seemed to form its basal axis. The bone at the base of these growths appears always to be very vascular and open in its texture. Considerable hæmorrhage followed the operation, which ceased under cold and pressure. For a few weeks the cicatrix furnished freely sprouting granulations; these were abundantly cauterised twice a week, and ultimately yielded a healthy scar. In structure this little mass when removed displayed a complicated vascular network, which, under the action of acetic acid, with the microscope, exhibited little else than an elaborate aggregation of the nuclei of blood-vessel muscle-

cells. The surface was clothed with epithelium and papillæ, like the gum. I believe that no danger can arise in these cases from the use of the knife in at once extirpating the tumour; the bleeding may be profuse for a minute or two, but it soon ceases.

"I have seen a vascular tumour connected apparently with the periosteum of a loose molar tooth, in which the hæmorrhage was very severe, occurring also at night to an extent that was really alarming; the tumour was a tense pedunculated mass attached to the side of an upper molar tooth, half of the fang of which was naked. The extraction of the tooth brought away the tumour with it, which immediately shrivelled up to half its previous volume, and became soft and flabby.[1]

"These tumours, as far as I have observed, occur in adult and middle life; they are perfectly innocent, and show no tendency to return when carefully eradicated."

In vol. v. of the *Pathological Society's Transactions* the same author alludes to a tumour of this nature, but it was pedunculated and therefore capable of more easy removal than in my case; moreover it did not pulsate. It had existed for about twelve months, and was situated on the outer side of the left upper gum. When removed it was the size of a Morella cherry, lobulated and vascular. It was not ulcerated at any part. It gave trouble by repeated bleedings, which occurred spontaneously or whenever it was touched. For some few weeks before its removal it bled during the night in such large quantities that the patient was often awaked by the blood trickling into the glottis, her person and pillow being saturated with blood. Upon microscopical examination the tumour was found to consist of a congerie of numerous blood-vessels and connective tissue with no cells. Mr. Salter concludes that this was a vascular tumour *par excellence*, perhaps of the nature of nævus. The similarity of structure to my specimen is very striking. True aneurisms by anastomosis, from pulsatile angiomata, have been described as occurring in the long bones, and have been eradicated from the lower end of the femur or head of the tibia by gouging. I have never

seen such a case. All the instances of pulsating tumours of bone I have seen and studied—and these have not been a few—have always contained sarcomatous structure, mixed with enormous blood sinuses and spaces lined with endothelium.

In a clinical lecture delivered at St. George's Hospital by the late Cæsar Hawkins, this eminent surgeon referred to the so-called aneurisms by anastomosis affecting the long bones, and referred to the case of Dupuytren, where the latter fruitlessly tied the femoral artery for this disease. Mr. Hawkins states his belief that all such tumours are really malignant in nature, and are such as we should now call soft pulsatile sarcoma. "If, then," he writes, "you meet in practice with elastic tumours of the bones, some of which pulsate, you are, I think, to regard them as malignant, and instead of tying the artery, the influence of which at best is but temporary, you ought, if possible, to remove the affected part."[1]

In the end it becomes my duty to justify the treatment I adopted in this very interesting case, which may seem to many needlessly severe and extensive. In the first place, it was clear, that as the patient had already lost a serious amount of blood, any inefficient treatment like partial excision or the cautery might have been followed by recurrent bleeding, and this would have led to a serious, or even fatal, result. The records of one of Mr. Salter's cases amply prove the obstinacy of the bleeding when these growths are cut or pricked. Next there was the great uncertainty of the true nature of the swelling. The ill-defined margins and general infiltration of the parts induced me to believe that the tumour was of a sarcomatous nature, and the grave mistake of dealing with such tumours by partial operations is too clear to need demonstration before this Society. Of aneurism by anastomosis, which this tumour closely resembled, I have had sufficient experience on the auricle and in the scalp to be strongly impressed with the perils of cutting into the growth itself—and this is

[1] "Clinical Lectures," by Cæsar Hawkins, F.R.S., vol. ii.

enhanced in the mouth, where bleeding is favoured by warmth and moisture, and prolonged pressure cannot be kept up. A free resection of this growth was in accordance with the soundest rules of surgery, never to cut into a vascular growth. There can be no doubt from the structure of the tumour, composed of a congeries of dilated vessels and sinuses, its ill-defined margins, and its violent strong pulsation, that we may rightly pronounce this case to be a definite instance of aneurism by anastomosis involving the vessels of the hard palate, and I cannot give any reference to an exactly similar instance. Such cases are doubtless as rare as they are dangerous and difficult to treat. The prognosis is highly satisfactory, for the free removal, and the comparatively innocent structure of the tumour make recurrence improbable, and there is every hope that a definite cure is ensured.

Mr. Albert said he had nothing to add to the paper except to mention a case that he saw, and to which, unfortunately, he was unable to give Mr. Sheild the reference. It was a case that occurred at the West London Hospital, in which a distinctly pulsating swelling occurred on the alveolar portion of the upper jaw. It was removed, as far as he remembered, without extirpation of any part of the bone. He remembered a case at St. George's which might be of a similar nature to Mr. Sheild's. It was that of a young man who had what was subsequently found to be a sarcoma of the upper jaw. It originated as a slight bulging about the level of the cheek. At Mr. Albert's suggestion it was punctured with a trochar and canula, but nothing came out except a little blood. A few days after a similar swelling appeared on the opposite side. This was also punctured with a similar result. Then followed repeated attacks of hæmorrhage from the nose and mouth, and finally a fungating mass appeared about the site of each canula puncture. One night the patient developed a group of secondary deposits over the abdomen and chest. They varied in size from a filbert to a pea, the more superficial ones being obviously discoloured. Some in the course of a few days diminished in size, and one or two almost dis-

appeared. The patient ultimately died from exhaustion, produced by recurrent hæmorrhages and pain.

Mr. W. B. Paterson said he had treated one case of angioma by incision and cauterisation. The tumour was small, about the size of a split pea, and situated on the outer side of the alveolus above the incisor teeth. Its small size tempted him to break the rule of surgery, not to cut into a vascular tumour which, under pressure, could be made to disappear. He cut into it, expecting bleeding, and was prepared with an actual cautery. It bled furiously for such a small thing. He was able, however, with the actual cautery to completely check it. The angioma was cured, but there was necrosis of a portion of the outer plate of the alveolus, the periosteum of which had been destroyed by the process of cauterisation. He subsequently met with another case somewhat larger in size, and he intended to deal with it in a different way. His idea was to deal with that case by passing two curved needles, threaded with stout silk, well down to the bone under the growth in cross fashion, tying the silk tightly under and around them, in the way that Mr. Sheild had described in Mr. Salter's case, and if necessary adopting further treatment by caustic or cautery as might be required. It was proposed that the patient should be taken into hospital, but the patient did not see fit to come. Hearing Mr. Sheild's case described it occurred to him whether if it had been a case simply of pulsating tumour, and Mr. Sheild could have felt perfectly certain in his mind that it was only a simple angioma, with no sarcomatous tendency about it, he could not have got at the posterior palatine artery at its exit from the posterior palatine foramen, and there, possibly by the aid of a little surgical "carpentry," cut off the blood supply of the tumour by driving up a wooden point or plug into the foramen and so compressing the vessels. Such a thing had been done before. He could not refer Mr. Sheild to cases, but no doubt he knew perfectly well all that had been done. This case might subsequently have been treated by extirpation of the tumour on the palate, and with the assistance of a dentist, risk of further hæmorrhage mimimised by a plate applied to the

surface of the palate and fastened to the teeth. Such a plate would have held the lint pads, &c., in place and kept up firm pressure for the control of bleeding generally. The plate could have been made before the operation at a guess of the normal position of parts, or from modelling composition at the time of operation as a temporary measure. Had the case been a simple one some such treatment might have been successful, but he quite saw the difficulty of Mr. Sheild's case. The tumour was certainly of a suspicious nature, and he, personally, thought, taking that view of the situation, that Mr. Sheild had done the correct thing in removing both it and the bone as well. The method he (Mr. Paterson) had referred to of treating a simple angioma, demonstrated that one must be prepared for necrosis of the bone after using the actual cautery. Mr. Sheild obviated necrosis in his case by cutting away the bone in the first instance, and possibly also any risk of further hæmorrhage on the separation of the sequestrum. Therefore, on the whole, Mr. Shield, did what was evidently the right thing to be done under the special circumstances of the case.

Mr. Marmaduke Sheild said he had very little to say in reply except to thank the Society for the kind way in which they had received his paper. The criticism offered by Mr. Paterson was a perfectly just one. If he had been certain that the case was one of aneurism by anastomosis, the bone being quite free, could anything else have been done besides removing a portion of the jaw? Of course the possibility of plugging the posterior dental foramen occurred to him at once. It was very easy to talk about but very difficult to do. He had seen it attempted after severe hæmorrhage in operations for cleft palate by distinguished anatomists and surgeons on several occasions, and had always seen them fail to find it. However, it was recommended in the books and it ought to be possible to do it. The reason for its rejection on this occasion was, that he felt a large pulsating artery, probably a posterior palatine artery which appeared to be as large as a crow-quill. Pressure upon this did not in the least influence the pulsation in the growth. The tumour was evidently supplied by arteries from every

direction, as is usually the case in aneurisms by anastomosis. He thought if he had seen the case before there had been much loss of blood, and whilst the patient was in a good condition, it would have been quite justifiable to have attempted to have cut away merely the growth and to apply some mechanical pressure such as Mr. Paterson suggested, but the difficulty to be encountered was the serious loss of blood the patient had already undergone. In his condition the result of such an operation might have cost him his life if it had failed, and severe recurrent hæmorrhage had again taken place.

Very often one could be wise after the event, and looking back upon cases might wish that some other treatment had been adopted, but with regard to this case if a similar one was presented to him again he should adopt the same course. He would only just add one word with regard to a point noticed in his paper, where he had spoken of slight recurring hæmorrhage which was checked by making the patient sit up, immersing the lower extremities in hot water, and injecting the buttocks with ergotine. There was no process so valuable as that for checking hæmorrhage in the mouth, and it was one of the most useful methods in dealing with those terribly troublesome cases which members of the Society must have met with, of recurrent hæmorrhage into the tooth socket, which he had seen on several occasions stopped by this means.

Report on a Case of Re-united Fractured Human Tooth, with some Remarks on the Healing of Wounds of the Dental Pulp.

By Mr. Storer Bennett.

In December, 1888, Mr. W. E. Harding presented to this Society an upper incisor, which had been fractured across the crown, and which he had extracted from the mouth of a girl 17 years of age, only three or four days before he presented it. The history of the patient was that some ten months previously she had fallen down, striking the tooth and driving it high up into its socket. It became

impacted, and remained fixed in its position, causing more and more irritation up to the time that Mr. Harding saw it. The pain gradually became so intense that there was nothing to do but to remove the tooth. He then discovered that it had been fractured across the crown, in a direction obliquely upwards and backwards. I was asked to make a microscopic examination of the specimen, and, therefore, removed a vertical section from front to back of the tooth, and the slide now exhibited shows the two outer halves remaining. It was seen that the broken portions of the specimen, though separated by a considerable interval, were firmly knit together by some calcified material which occupied the central portion of the gap. The margins of the space, however, being occupied by a substance of leathery consistence, were not calcified at all. Examined microscopically, the uniting substance was seen to consist of a calcified material of a spongy or cavernous character, with numerous spaces for blood vessels. The cavernous spaces had apparently been occupied by a substance somewhat resembling pulp, though I do not wish to affirm that it was pulp. In various positions slight absorption of the edges of the normal dentine has taken place, the spaces thus formed being filled up by cementum showing well-marked lacunæ and canaliculi. The amount of cementum, however, is not very great.

The next slide is a magnification showing the intermediate tissue. Spaces are seen which have been occupied by blood vessels, and from the black masses little tubes here and there may be seen passing, but there is no space where one can make out a distinct brush of tubes going off, as one would expect if a mass of dentine were present.

The next slide shows a smaller portion of the same thing more highly magnified, but I do not know that it adds any greater amount of clearness to the idea of the specimen. An examination of the specimen suggests to one's mind two different sources for the supply of this new material, either pulp or periosteum. The pulp was exposed, but only to a very slight extent, and, of course, it is possible to imagine that enlargement took place, that the overgrowth of the

FIG. A.—Mr. W. E. Harding's case of fractured and re-united upper incisor reported on by Mr. Storer Bennett. Section including the seat of fracture, and showing uniting tissue.

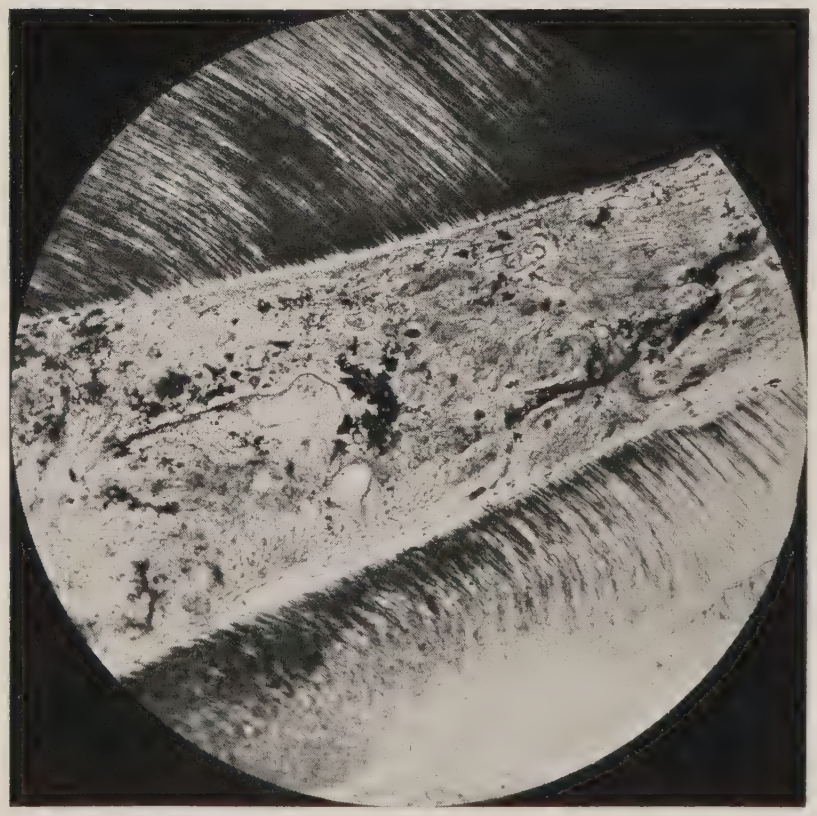

FIG. B.—Magnification of the central portion of uniting tissue seen in Fig. A.

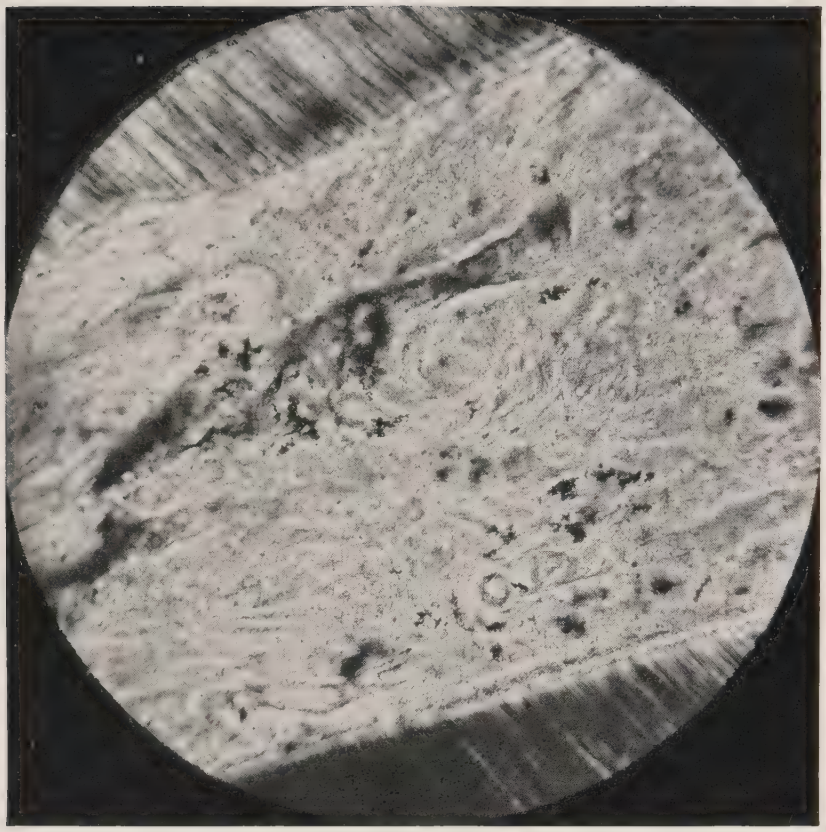

FIG. C.—Still further enlargement of uniting tissue than seen in Figs. A and B.

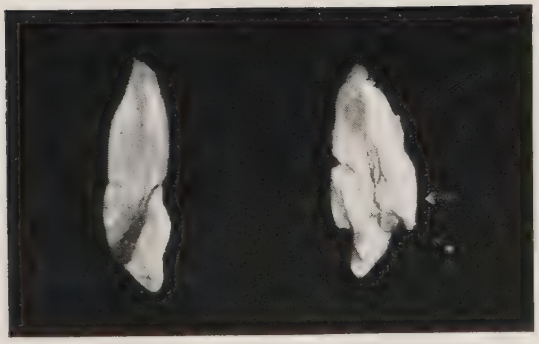

FIG. D.—The two outer surfaces of tooth from which the section (Fig. A) was removed. The leathery uncalcified uniting portion is well shown at the spot marked by the arrow.

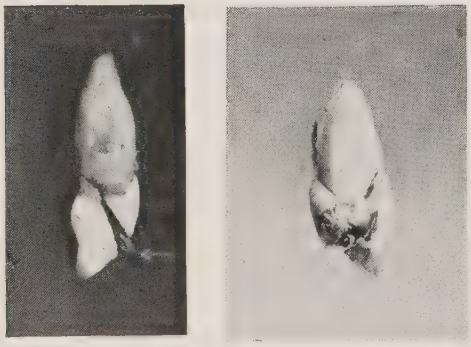

FIG. E.—The inner surfaces of the preceding figure (Fig. D), and from between which the microscopic section (Fig. A) was removed. The communication is well seen in the section marked by the arrow.

pulp filled up the space between the two fragments somewhat similarly to the way that chronic enlargement occurs in cases of polypus of the pulp, and that ultimately this calcified.

On the other hand we have evidence that there is cementum in the section, lacunæ and canaliculi being present in certain parts in rather large numbers, and we have *not* the evidence of any definite dentine structure asserting itself. We know that bone may be produced from many tissues other than those which naturally give rise to it. We have here, I think, a case in which hæmorrhage having taken place, a natural capping of the exposed pulp occurred, somewhat similarly to the way a wound heals under a scab. Blood was poured out between the fragments, organisation took place, numerous blood vessels were produced, and ultimately calcification occurred, and eventually if it had been left long enough I think the whole of the space would have been filled up with calcified material more or less resembling bone, or bone and cementum together. There are many specimens described where cementum has united a fractured tooth in the root, but I think we have here to do with a specimen unlike any other that has been figured or described, in so far as the cementum has been deposited between the fractured portions of the crown. I regret the report has been so long delayed. I ought to have presented it years ago, but perhaps there is one fortunate circumstance connected with it, and that is that Mr. Tomes has come across a fractured tooth which will compare with this, and no doubt we shall listen to some very interesting remarks from Mr. Tomes in the comparison of his own specimen with this one.

A Case of Calcification of a Widely Exposed Pulp.

By Mr. Charles S. Tomes.

The specimen to which I would call your attention is one so remarkable, and also so instructive from several points of view, that it will fully repay somewhat close examination.

The tooth is one which, having been broken right across

its pulp cavity, has, nevertheless, succeeded in repairing the damage and sealing it up again—an event of such rarity that I only know of one other recorded case, namely, that to be found figured in my father's "Dental Surgery" (third edition, p. 341). Had my specimen been quite unique I should have hesitated to cut it up for microscopic examination, and then should have missed what, to my mind, are the points of greatest interest it has to show. The tooth is either a lower wisdom or a somewhat small second molar, the loss of the neighbouring teeth rendering its exact determination impossible.

The patient is a servant of a patient of mine, and was brought to me on account of very severe but intermittent pain of a neuralgic type, recurring most days, but not every day. I found a tiny opening in the gum, which was otherwise of healthy appearance. A probe introduced disclosed the presence of what felt like a complete but rather rough-surfaced tooth. The history was that some three years previously an attempt had been made to extract a tooth in this situation, but that it had been broken off. It was exquisitely tender, and occasionally very painful for a long time afterwards, but it gradually got better and healed over, but it never remained absolutely comfortable for long together, although the severe paroxysmal pain which brought her to me was only of a few weeks' standing. With the aid of cocaine I reflected the gum from over it, and subsequently had no difficulty in removing it with an elevator. I then found that it had been transversely fractured a little way above its neck, and that what should have been an open pulp cavity was occupied by a cauliflower-shaped mass of shining polished ivory projecting above the original surface of fracture and overflowing on to it. By cutting it carefully with a hair saw I was able to get four good longitudinal sections, and found that the pulp was not wholly calcified, but that a residue of the pulp chamber was still occupied by living pulp. On examining it with a low power the large mass of secondary dentine was found not only to project a good way above the general level of the fractured surface, but also to have, so to speak, over-

flowed it all round the orifice of the pulp cavity, and to be everywhere closely adherent to—indeed, continuous with—the old dentine. Roughly speaking, its structure may be thus described: its free or upper surface presented distinct lamination parallel with the surface; next came irregular lacunal spaces; then sparse dentinal tubes; and finally, in its deepest portion—which was inside the original pulp cavity—abundant dentinal tubes, which were in places continuous, though oftentimes joining by an abrupt bend, with the dentinal tubes of the original dentine. The overflow on to the fractured upper surface of the original tooth in places was slight, in other places it extended in a gradually thinning layer out to the very edge of the tooth (fig. 4); but what was especially noteworthy was that there were included in the new calcified growth quite a number of entirely detached and displaced splinters of the old dentine (figs. 6, 7 and 8).

To proceed to a somewhat more detailed description of the new tissue.

The Laminated Outer Layer.—This consists of laminæ parallel with the surface, and varies in thickness, reaching in places $\frac{1}{250}$ inch, and containing about ten well-marked layers. Here and there it constitutes the whole of the overflow, and it contains some canaliculi, taking a direction perpendicular to the surface, and a few well formed lacunæ with their canaliculi. It is present everywhere, though its amount, and the distinctness of the lamination are variable (figs 2, 3 and 5).

The Lacunal and inter-Globular Spaces.—The tissue immediately below the laminated layer is characterised by an immense number of lacunæ and inter-globular spaces, which are in parts well formed and in other parts very coarse and irregular (figs. 2, 5, 6 and 9).

The fine boundary of this region of lacunal spaces is in places well defined, and terminates with bodies of the encapsuled lacuna type (fig.); elsewhere it passes insensibly into the region occupied by tubes, in the outer part of which latter region interglobular spaces are abundant, and are somewhat irregularly disposed.

The Tube System.—In the centre of the tooth the tubes, like those of normal dentine, run vertically upwards towards the surface, while towards the sides of the new mass they radiate outwards, passing thus beyond the limits of the fractured old dentine, and spreading themselves fan-like over the edges of the original tooth (figs. 2 and 3) to a certain extent.

In that portion of the secondary dentine which lies within the old dentine (which latter constituted originally the lateral walls of the pulp cavity), the tubes run more or less outwards, and are joined up into continuity with the old dentinal tubes, there being generally an abrupt bend and some dilatation at the junction (fig. 10).

From an inspection of figs. 2 and 3 it will thus be seen that the whole boundary of the resultant pulp cavity, formed at its sides and below by the original dentine and above by the new secondary dentine, is formed of dentinal tubes of normal appearance, and that the pulp, though diminished in bulk, has almost perfectly normal surroundings over nearly its whole area.

As the tubes run outwards they become more widely separated, owing to their fan-like spreading; it is noteworthy that there are not a greater number of tubes in the expanded portion, but that the interstices between them become larger. A good many short lateral branches are given off, such as those which occur abundantly in the dentine of the roots of normal teeth.

Towards their outer extremities many of the tubes show longitudinal dilatations, and are joined up to the canaliculi of lacunal spaces; some end in brush-like expansions, while others terminate in loops, the loops being common to two or more tubes; others are sharply bent back on themselves (figs. 9 and 7). At and above the ends of the tubes fine globular formations may here and there be very distinctly seen.

The included Splinters of Dentine.—As has already been mentioned, this specimen is probably unique, in that the secondary dentine mass contains quite a number of little detached pieces of the original dentine of the tooth which

were splintered off in the original attempt at extraction, and which have become solidly enclosed in the new formation (see figs. 2, 7, 8 and 9).

They have been displaced in various ways so that their tube systems run in all sorts of directions, and are in no way conformable with the tubes of the new growth (figs. 7, 8 and 9). But they have, in their irregularity of position, this much in common, that the tubes of the new growth, when they are of any size, do not pass beyond them, but terminate beneath them (fig. 7, 8 and 9). To this, however, there are some exceptions, where quite small chips appear to have been driven more deeply into the pulp.

Upon the whole, then, it may be said that the broken fragments of old dentine either lie imbedded in the region of lacunal spaces, or between this and the commencement of the tube system. It is not a little remarkable that none of the fragments show the least sign of absorption, but that their edges are left quite angular, just as they were broken off. Where the tubes commence close against the fragments they are bent about, obviously with relation to the included pieces.

Marks of Absorption.—It is notable that notwithstanding the violent irritation to which the pulp was subject, in very few places can any mark of absorption be found.

The occurrence of "encapsuled lacuna"-like forms has already been mentioned where the lacunal region merges into that of well-formed tubes, but a few marks of absorption and subsequent calcification are to be found elsewhere, and in unlikely places. Thus (fig. 4) under the calcified overflow are some pits occupied by Howship's lacunæ.

Everyone must, I think, agree with me in astonishment at the extraordinary vitality of this pulp and its amazing success in repairing damages, and it is worth while to examine, or at least to speculate, upon the conditions under which this took place. The whole roof and a little of the sides of the pulp cavity had been torn off, and the pulp thus widely exposed, apparently a little below the edge of the gum. This must have been temporarily protected by the

formation of a coagulum, and ultimately by the contraction of the edges of the gum and its almost complete healing over it, and under these conditions its extraordinarily successful calcification went on.

Is there not a practical hint to be derived from this? Here was a lacerated pulp with loose fragments of sharp splintered dentine jammed into it, coated over only with coagulum, and it did not die nor inflame, but calcified. I think that in capping a pulp, and especially a traumatic exposure, we should probably do better to avoid wiping away any blood or exudation, but leave the effused blood to coagulate; we can put nothing better upon the pulp surface. And probably, when we do commence to cover it, we should do best to put something organic — sterilised fibrin or gelatine, for instance—and I shall certainly try such a course of procedure when the opportunity offers, and refrain from placing in contact with the pulp either inorganic materials as a vehicle for medication, or any strong medicaments.

But there is another and less hopeful side to the suggestions presented by this case; there was almost complete success in the formation of secondary dentine, with absolutely no loose nodules or irregular encroachment on the pulp—in fact, precisely the condition which we hope to obtain when a pulp is capped; and yet it was not comfortable, and notwithstanding its full protection under the gum it became the site of very characteristic pulp irritation, and consequent neuralgic pain.

Was this an accident? or is the capping of pulps to end in this way usually? Clearly we can hope for no better results in the way of repair; yet why did it become so painful? For all that we can see *post-mortem*, the immediate surroundings of this pulp had become almost exactly those of a healthy pulp, with its dentinal tubes radiating from it.

Another set of speculations of a more theoretical kind arises, how was the calcification done? Ordinarily the odontoblasts would be torn off and remain adherent to the portion of the tooth which was broken away in the

attempted extraction. Were they not torn off, or were they reformed, or was it all done without odontoblasts? If so, then dentinal tubes can be manufactured without odontoblasts, which, from what we know of the process, does not seem likely. But in any case, the first formed or outer layers are laminated, unlike anything which happens in normal tooth formation. Were these laminated layers a plastic exudation shed out from the wounded pulp, subsequently organised and finally calcified? I confess that this idea rather commends itself to me as it would give an easy explanation of the way in which the new tissue flows over the fractured surfaces exactly as if it had got there in a fluid form.

One section (fig. 11) seems to afford clinical proof that the material which subsequently calcified was originally fluid. A piece of old dentine has been raised at one end, but left attached at the other, just as happens if a chisel is driven into wood nearly parallel with its surface, but the chip not detached. This has been glued on by something which ran in right under the raised portion with a degree of completeness which strongly suggests its original fluidity.

The same idea is equally strongly suggested by the manner in which the overflow, subsequently calcified, ran out in places over the whole fractured top of the tooth, reaching even to its very outside in a gradually thinning-out layer (figs. 2 and 4).

So far as it is possible to read the history of events this appears to have happened. The roof and part of the sides of the pulp chamber were torn off, and the exposed part, probably retaining its odontoblast layer, swelled out somewhat from the orifice (as indicated by the fan-like expansion of the tubes), and shed out, as it certainly would, plastic exudation over its whole surface, which flowed out over the top of the tooth left. This plastic exudation became permeated by migrating leucocytes, and in and under it the fragments of dentine were enclosed. This was protected by blood-clot, and ultimately by the healing over of the gum, &c. This organised exudation afforded the means for the calcification of the laminated and also of the

lacunal tissue, and also for the absorption, and ultimately formation of lacunæ of Howship where this had happened. After the fibrillation and organisation of the effused plastic exudation, the pulp itself commenced to calcify in the ordinary way, its odontoblast layer determining the number and form of its tube systems. That this was the case is indicated by the fact that, though the area is larger, there are not more tubes, but only larger interspaces between the tubes, on its expanded portion, and so far as it goes points to there being neither a fresh formation nor multiplication of the odontoblasts. They were stretched apart, and so in the stretched portion the tubes are far apart, becoming dense in the more expanded portion. Thus, so far as it goes, it is a strong confirmation of the view that a dentine tube is a consequence of the presence of an odontoblast. The fragments of dentine, with the exception of a few small pieces which were driven in more deeply, lay on the surface of the pulp, and were stuck to it by the plastic exudation. Hence the dentinal tubes commence under them (with trivial exception), and mark the limits of pulp tissue and of exudation tissue.

For the very beautiful photographs which illustrate this paper I am indebted to Mr. Mummery, to whom I am also indebted for looking through the proofs of this paper with a view to seeing if anything of moment which had struck him in looking through the specimens had been omitted.

DESCRIPTION OF FIGURES.

Fig. 1.—Surface of Welch's amalgam, showing the occurrence of crystalline forms, mostly six-sided rhombs. The photograph does not show the beautiful brilliancy and sharpness of contour of the crystals, but it is a difficult object to photograph, owing to the differences of plane and the small amount of light obtainable by the illumination employed. It required three-quarters of an hour's exposure on a rapid plate.

Fig. 2.—General view of the mass of secondary dentine, showing the pulp cavity beneath it and the dentine of the original tooth, which comes out very dark; the lighter portion is all new growth. The direction of the fracture is well seen, in the step-like shape on the left side, where a large piece of the side of the pulp cavity is gone, whilst on the right side the fracture has run in a more irregular and oblique direction. This also shows the lamination of the outer layer, the coarse lacunal structure of certain parts, the general trend of the dentinal tubes, and a long thin slip broken off the old dentine and now embedded in the new growth.

Fig. 3.—Another general view of the secondary dentine formation. This shows many of the same points as *fig.* 2, but the outer laminated layer is less distinct.

Fig. 4.—A portion of the overflow lying on the top of the fractured surface of the original dentine. No dentinal tubes are to be seen in this section, but towards the left are some absorption pits filled up by subsequent calcification. This is the left hand part of the overflow in *fig.* 2.

Fig. 5.—Another part of the overflow. The lamination of the outer layer, probably calcified plastic exudation, is very distinct. To the left is coarse lacunal tissue, with no dentinal tubes visible in it. This is the extreme right hand edge of the new growth in *fig.* 2.

Fig. 6.—A portion more highly magnified, in which coarse lacunal tissue is seen extending deeply in between dentinal tubes of the new growth. To the right a small portion of the original dentine is visible. This is taken from the extreme right hand of the new growth seen in *fig.* 3.

Fig. 7.—The end of the small, thin slip of old dentine, detached and far removed from its original site, and so displaced that its dentinal tubes run horizontally, at right angles to those of the secondary dentine in which it is enclosed. This is a more highly magnified representation of the right hand end of the slip shown in *fig.* 2. Above and outside it is coarse lacunal tissue, beneath and inside it the tubes of the new growth. Doubtless this displaced slip lay on the surface of the pulp, to which it was at first glued by plastic exudation.

Fig. 8.—Another portion of displaced old dentine. The tubes seen beneath it at the bottom of the figure belong to the new growth, and not to the old dentine.

Fig. 9.—Another piece of old dentine close to the surface of the new growth. This shows well the relations of the secondary dentine tubes to the fragment, they not passing beyond it, except to the right, where they, to some extent, curl round its edge. The abundance of interglobular spaces is also apparent. This is the superficial and central part of the new growth in *fig.* 3, more highly magnified.

Fig. 10.—Secondary dentine formed within the walls of the original pulp cavity. The continuity of the tubes with those of the old dentine, though sharply bent at the junction, is well seen, whilst at the top and left of the section is seen the original fractured surface, at this point devoid of any overflow.

Fig. 11.—From the upper surface of the original tooth a small splinter of old dentine, not wholly detached from the rest, but still adherent to the left. The gap formed by its right hand end being raised has been filled up by new tissue, which has run under it with some completeness, as to suggest that it went there in a fluid form.

With the exception of No. 1 all the photographs were taken by Mr. Mummery.

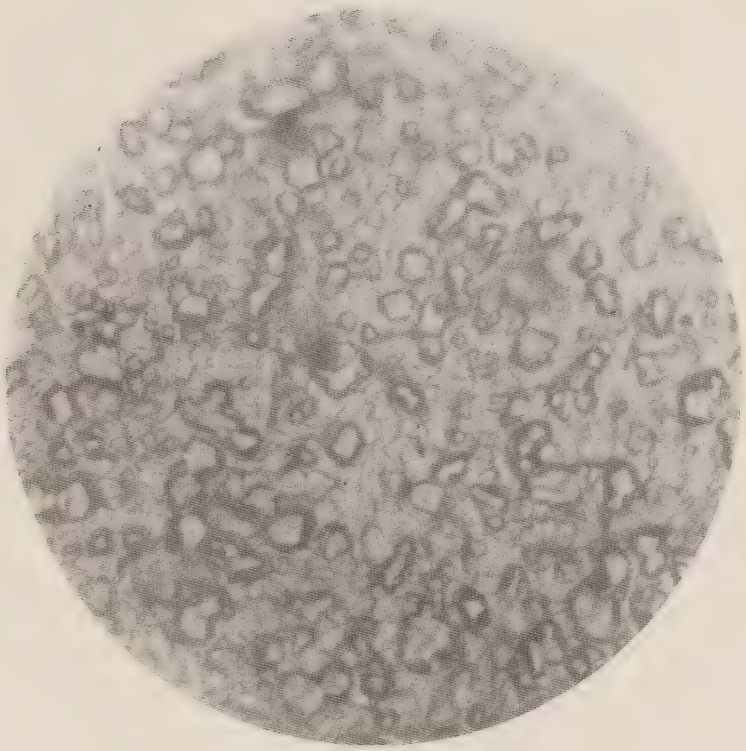

Fig. 1.

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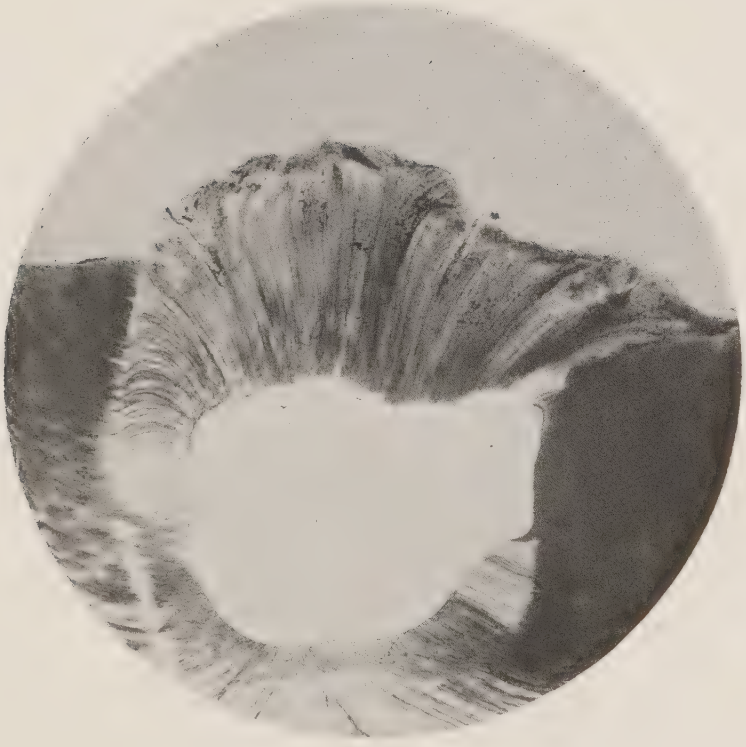
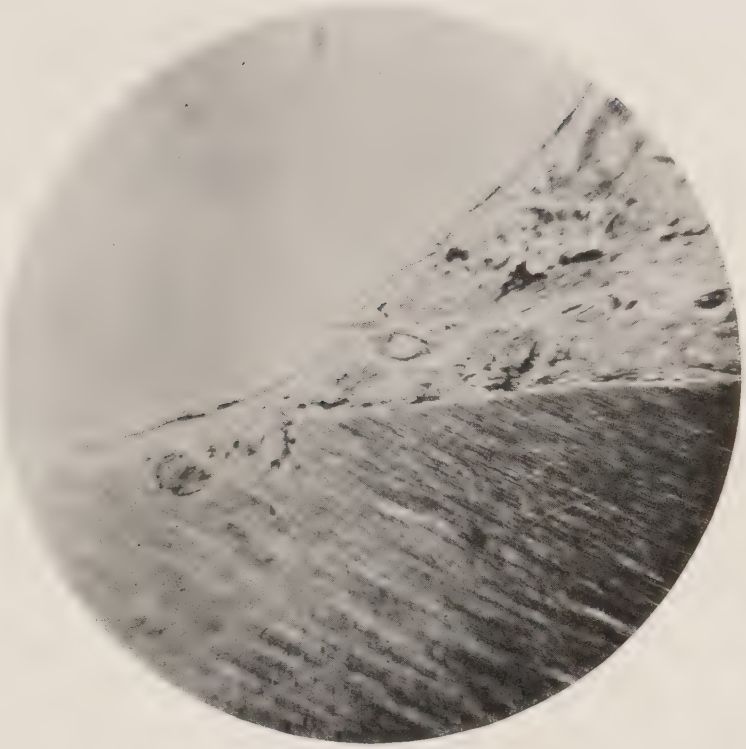


Fig. 3.



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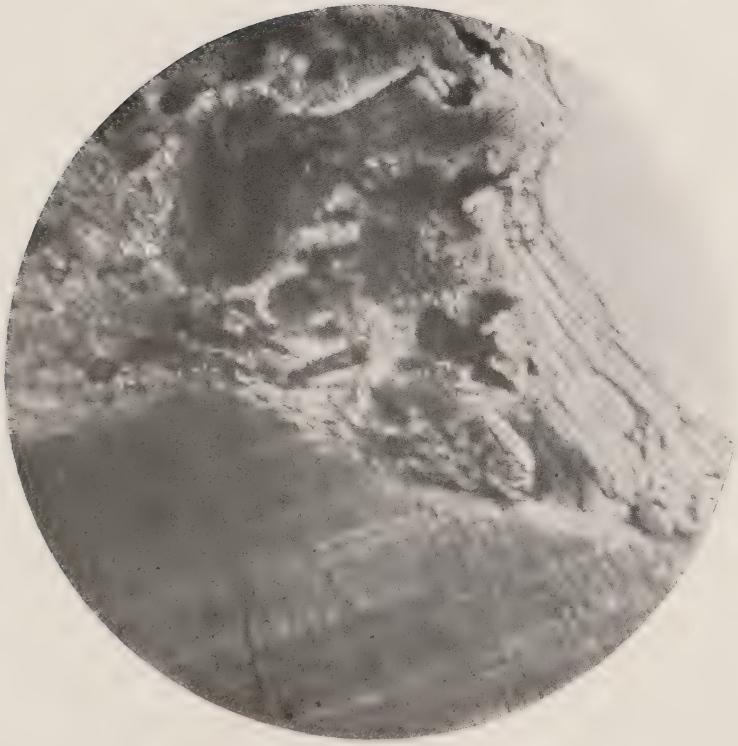

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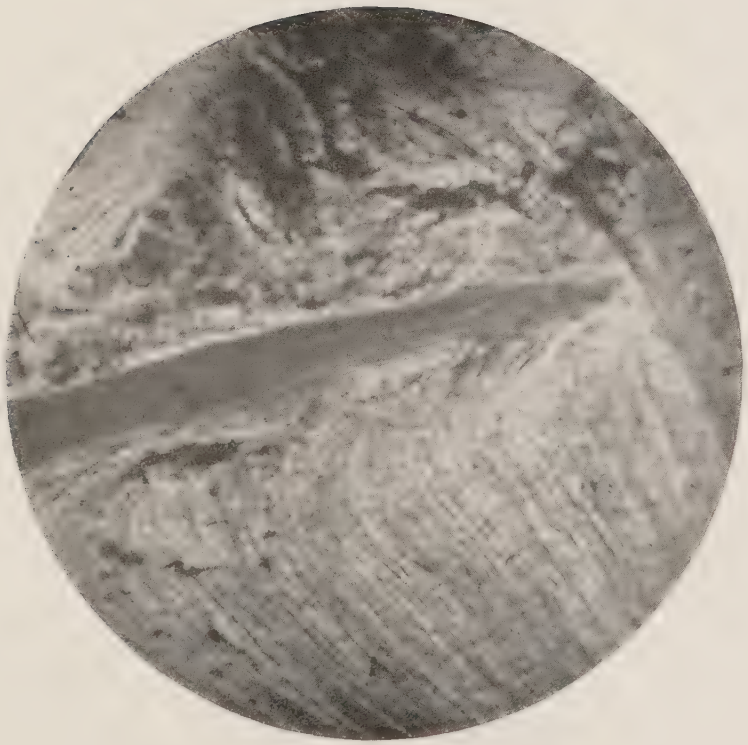
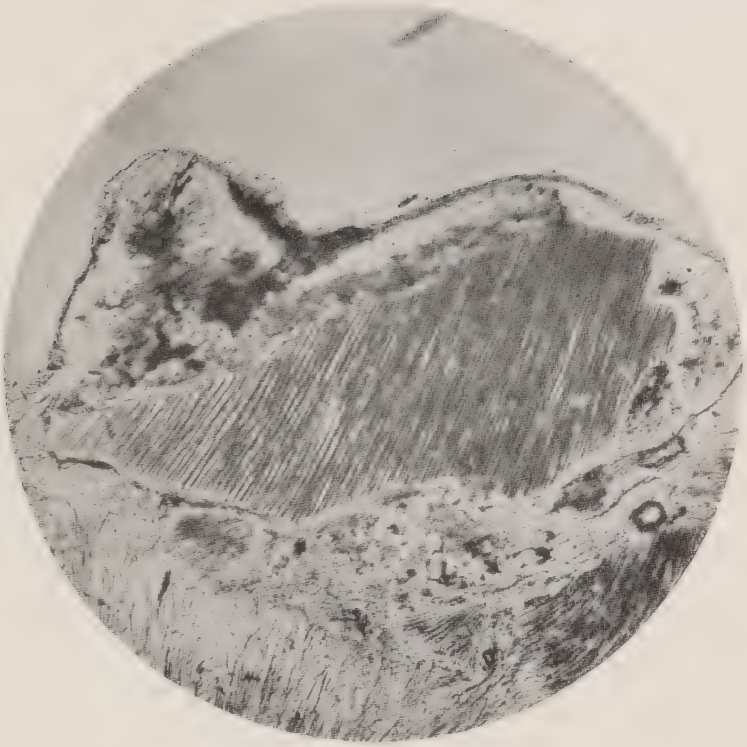


Fig. 7.



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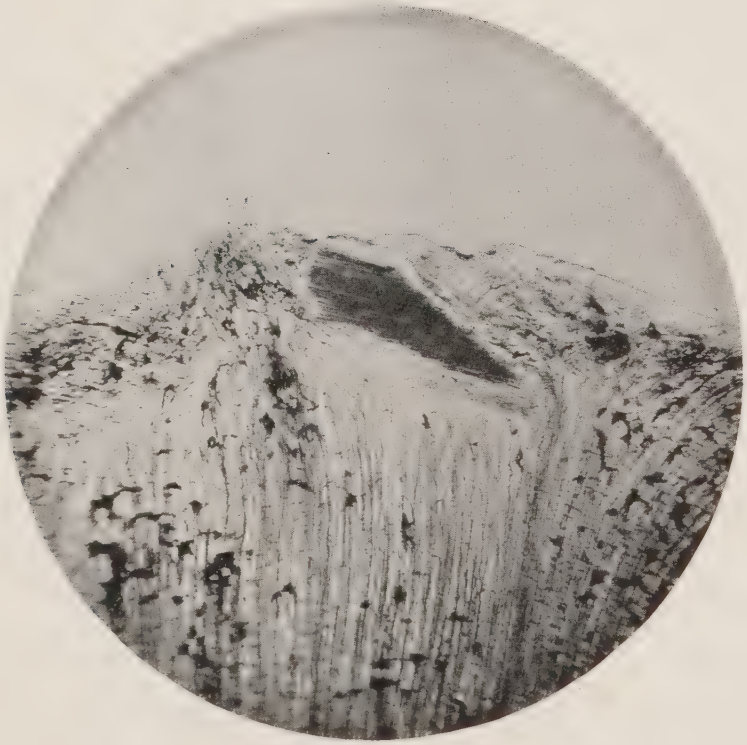

Fig. 9.

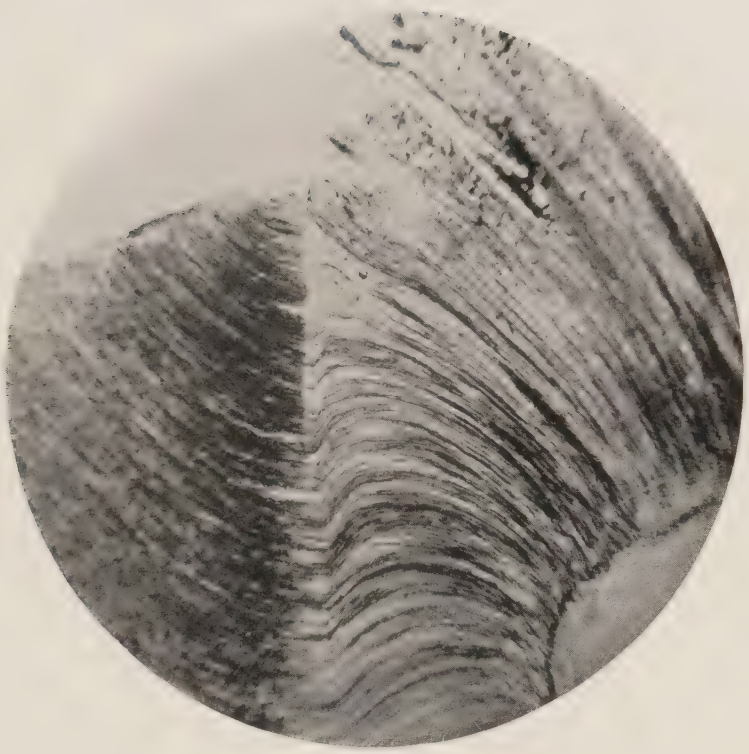

Fig. 10.

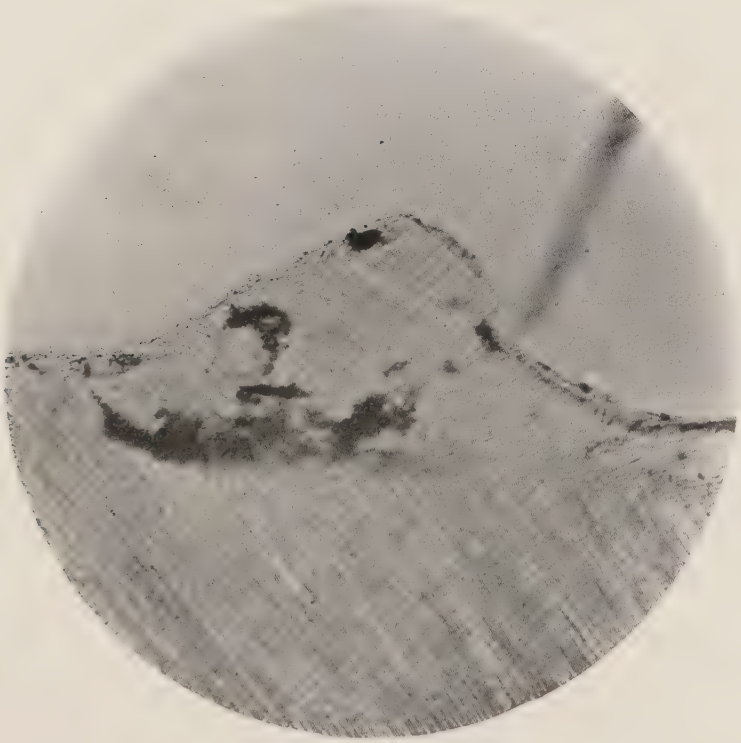

Fig. 11.

Further Notes upon Amalgams.

By Charles S. Tomes, M.A., F.R.S.

In a former communication upon this subject, I pointed out that some advantages not otherwise obtainable were to be got by causing an amalgam to set with a rapidity which is so inconvenient as to almost preclude its employment in the more difficult class of cavities, and this difficulty of manipulation practically greatly diminished the usefulness of the method. I will only recapitulate what was then said so far as to mention that the good results as regards the ink test were got by the admixture of a certain proportion of old amalgam which had already set, but which was softened by heat and then rubbed up with the fresh mixture.

The idea of using old amalgams softened by heat was, as I have already mentioned, propounded by Dr. Otolengui, for finishing the surface of fillings, and as long ago as 1880, was mentioned for employment for the whole of a filling by Mr. Bodecker in a letter written to

the *British Journal of Dental Science*, but it appears to have fallen stillborn.

With a view of rendering this or some similar method more generally available, I have since that time made a number of experiments, the results of which I propose to set forth this evening. If a little amalgam be mixed into a plastic condition and spread out in a thin layer upon a microscopic slide, its surface can be examined by illumination from above, the best method being that by light reflected down through the object glass, by means of an inclined slip of glass in an attachment screwed on between the objective and the body of the microscope.[1] The bright surface will be seen to have a smeary semi-fluid appearance, with numerous spherical or hemispherical projections upon it which look like, and doubtless are, beads of mercury. As time goes on these beads are found to have wholly disappeared, and their place is occupied by crystalline forms of metallic lustre. These crystals are sometimes cubes,

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[1] Such an apparatus was formerly made by Powell and Lealand. The light is admitted through a hole on the fore face, into which it is condensed by a bull's eye. The definition (with powers up to 8 mm. or even higher) is not sensibly interfered with by looking through the inclined slip of glass, and the objective acting as its own condenser, the light is well focussed on the object.

sometimes six-sided, rhombs and, apparently, sometimes flat plates with six sides (fig. 1).

Thus it would appear that the process of setting of an amalgam is one of crystallisation, the metals being at first partly dissolved in the mercury, and then slowly forming with it a crystalline compound. And I found further that if a slide which had thus become crystalline be heated, the beaded appearance returns, just as some salts containing water of crystallisation will melt in their own water. But in this case (of amalgam which had once set) the crystals re-appear in a few minutes, almost as soon as it has cooled. And I found also, that if a slide of freshly mixed amalgam be heated, the crystals appear at once instead of taking some hours to form ; that is to say, that heat brought about the immediate setting of the amalgam, indeed as soon as it had cooled.

Three slides were then prepared, one with amalgam mixed so as to be just barely plastic, a second with more mercury, and a third mixed with a considerable excess of mercury, and then squeezed till only just plastic, whilst the expressed mercury was squeezed flat under a coverglass on a fourth slide.

An examination of these slides showed no material difference in the size or appearance of the crystals formed, with the exception of the

fourth, in which no rhombs appeared, but only foliaceous forms similar to those in which tin crystallises. This crystallisation is the reason why an amalgam ordinarily used gets a mat surface when it has set, though left with a burnish upon it.

And this crystallisation takes place not only on the free surface, but also on that which is intact with the slide; and as it occurs on all that surface of amalgam which is in apposition with the walls of a cavity, the setting of the amalgam renders the contact less perfect.

A careful examination of the slides indicates that the mass is wholly built up of crystals, and that they are for the most part rhombs of about $\frac{1}{800}$ to $\frac{1}{1200}$ of an inch in diameter, and about twice as long as they are wide; as many of them —in fact the majority—stand up on one end on the free surface, it has a sort of resemblance to a pavement epithelium, but it is also on a minute scale furry. The driest of the samples has not so lustrous a surface as the others, even the under surface which is in contact with the glass being less bright, and this is seen to be due to the presence of a certain amount of dull granular-looking material.

All these slides were prepared with Welch's amalgam, which was selected because it is one of simple and known composition, containing only

silver and tin in known proportions—tin 51·52, silver 48·48, or nearly atomic proportions; and the tendency of thin slabs to curl up as they set, which has been described by several observers, could hardly be detected in any of them, they all remaining nearly flat.

The size of the crystals differs greatly in different amalgams; thus in the case of Eckfeldt and Dubois' standard amalgam[1] they are about half the size of those in Weld's amalgam, and in the case of precipitated silver they are even smaller. In this connection it will be remembered that precipitated silver has long been known as forming an excellent filling, though it discolours the teeth greatly. It may be that this sprouting of crystals all over the surface is the cause of some amalgams which fail to show any expansion by the specific gravity test, nevertheless breaking glass tubes in which they are packed. But it must also be remembered that it is not certain that the crystals do sprout up; it may be that the intermediate portions sink.

We have, perhaps, here an intelligible explanation of the addition of old amalgam reheated and mixed with fresh amalgam, causing

[1] Silver 52, tin 40·60, gold 4·40, copper 3 (from the "American System of Dental Surgery").

very rapid setting of the whole. Not only does the old amalgam tend to re-crystallise as soon as it cools, but it causes the new to do likewise. Just as a crystal dropped into a saturated solution of certain salts in water causes the immediate crystallisation of the whole, so apparently does the crystallisation of the old bring about that of the new. It remains to be seen what is the practical application of these facts. In the first place, with any freshly mixed and comparatively slowly setting amalgam, we cannot control the surface—it will become covered with small crystals, however smooth it may have been made at first. And though these crystals are very small, this roughening of the surface is not a change in the right direction. But these crystals are not dead hard; as I pointed out in my former paper, if an amalgam setting with inconvenient rapidity be burnished in, its surface remains smooth and burnished, and retains, to a great extent, its burnish; and if examined microscopically, the characteristic crystals can only to a very slight extent be discovered. So far, then, it must be right, only unfortunately it is so difficult to do. And here comes in the very interesting discovery of Dr. Black, which he terms the "flow" of amalgams. He found that by the steady pressure of a strong spring a foreign body could be squeezed into an amalgam

which had set without any apparent breakage or crushing occurring. This I can confirm. The form in which I tried the experiment was to take a piece of platinum wire and squeeze that upon the mat surface of one of my fully-set amalgams, with the result that not only did a dimple appear, but on examining under a low power, the longitudinal striæ, due to the drawing down of the platinum wire, were exactly reproduced, and the crystalline structure had wholly disappeared in the bright pit. In other words, the crystals are plastic, and the hard amalgam is capable of taking an impression of a degree of delicacy which it will not when fresh; or, to speak more accurately, which it will neither take nor retain when fresh, so that here again is an argument in favour of the immediate setting.

But although "flow" of amalgam is a most interesting fact and differs from mere softness, such as that of lead, in that time is required and the result cannot be got by immediate pressure, yet I do not for a moment believe that it has, as supposed by Dr. Black, anything to do with the ultimate failure of amalgam fillings, for I doubt if the very intermittent pressure to which they are subjected would bring it about.

The crystallisation may have something to do with the brittleness of thin edges of amalgam, and those with the smallest crystals might be

expected to be the strongest in this respect; and it is an argument in favour of lining large cavities with phosphate cement, which always makes a water-tight fit.

And here let me add one word as to the composition of amalgams. I believe that an enormous amount of experience in the hands of countless operators has been utterly wasted through our being content to use amalgams the composition of which is unknown to us; for my own part, since I have been experimenting I have resolved to use no amalgam the composition of which is not known to me, and I think that the manufacturers would do well to always publish it on the bottles; it is not as if it were a secret which could be kept, as it merely involves the expenditure of a little time and trouble to make an analysis, or the expenditure of a few shillings in getting it made for one.

Now to turn to actual practical manipulation. If a fresh mix of amalgam be put upon a hot plate, heated till it just begins to swell, it sets almost instantly, and can be used almost like fusible metal with a heated burnisher, being picked up by the cup end of the instrument; this method is of use in finishing fillings, as they can be got perfectly hard by this means at once. But as a concession to the weakness of the flesh, some of the advantages of the use of an incon-

veniently rapidly setting amalgam can be got by adopting the following course. A little amalgam is mixed in the ordinary way and rubbed round the cavity. And here I may say that I strongly adhere to the opinion which I have expressed before in several places, namely, that if a fresh amalgam is to be used, there is no method which in its results approaches that advocated by Dr. Bonwill. This, which is or should be sufficiently well known, consists in squeezing the amalgam in the cavity, that is to say, using it fairly plastic, and forcibly squeezing out the excess of mercury by means of little pledgets of wool or bibulous paper. By this method, and by this alone, have I sometimes got quite water-tight fillings with a fresh amalgam.

To return to our cavity. After the lining has been thus inserted and no great proportion of the total cavity filled (and it does not much matter if it gets wet at this stage), a mix is made of the rapid setting amalgam, which can then be easily squeezed into that already in the cavity and rapidly burnished down as it sets. A very convenient way of managing this is to mix up some amalgam to a barely plastic condition, spread it out thin, and after it has set break it up in a mortar. This is mixed with an equal weight of fresh filings and kept in a bottle ready for use; when required it is heated in a spoon

till the mercury shows a little, and then quickly rubbed up with some more mercury.

This mixture does not set with such rapidity but that it may be fairly easily used alone.

In the case of the standard amalgam, the mixed filings require a little more than their own weight of mercury to make a convenient mix, and an altered form of the balance issued by Mr. Fletcher comes in conveniently for this purpose.

The amalgam already in the cavity is, if necessary, again dried, and perhaps some of it removed, and the rapidly setting mass packed in. In this way the practical difficulties are removed, and the results are very good, as the surface and edges all consist of the rapidly setting amalgam; or the filling may be finished by using pieces of new amalgam picked up from a hot plate; if it has set before you have done, heating the instruments, and heating each added piece renders it again plastic. The proportions given, I need hardly say, would vary for different amalgams, and as experience is gained less mercury, or a larger proportion of old amalgam can be used. It is of course only possible to set forth a general outline of the outcome of my experiments.

In conclusion, I would mention one or two pitfalls which may have discouraged some who have tried to follow the lines at first indicated.

Unless the cavity be a simple one there is a danger, if every part be not thoroughly burnished, of leaving crumbly places in the amalgams, especially in undercuts.

Then, again, in using old pieces of amalgam there is an uncertainty as to their composition, and still more as to the quantity of mercury that they contain, which militates against constant results; for this reason I advocate a specially prepared old amalgam. And it is possible—indeed most probable that different amalgams will respond best to different treatments, hence I have kept to one single kind.

For the intelligent use of amalgam I would bid you remember that amalgam even fully set has, as shown by Dr. Black, a certain sort of plasticity; that in this state it takes moulds of exquisite precision; that the nearer it is to its full setting the better your chances of attaining this excellence; that heat resoftens it, even to the extent of fluidity; and that thus treated it sets again instantly.

I am only too well aware that these observations merely touch the fringe of the subject, and that the fact that amalgams crystallise has been, in a vague way, long supposed to be the case. But I do not think that any exact observations on their crystallisation are to be found on record. I have not as yet examined any amalgams which

of themselves set with very great rapidity, and my only apology for submitting observations so incomplete, is that the subject is so large and so difficult that it may not be threshed out in our time, and the more observers there are at work the better the chances.

Discussion.

Mr. F. J. Bennett said there was one point he wished to ask Mr. Tomes, viz., whether he had investigated anything beyond amalgam, a mixture of a metal with mercury. A most interesting account had recently come to his notice of investigations carried out by Professor Roberts-Austen, who appeared to have been working at alloys at different temperatures, in the fluid state, and recently in the solid state, and had obtained most remarkable results. The statement which he found in the scientific column of the weekly *Graphic* was that the Professor took cylinders of lead about three inches long, attaching to the end of those cylinders a small cylinder of gold of similar diameter. Keeping those two cylinders at a temperature far below the melting point of lead—in fact very slightly raising the temperature—after three days he found the astonishing result that particles of gold had found their way right up to the top of the lead cylinder in considerable quantity. It occurred to him (Mr. Bennett) that possibly some of the very successful and happy results recorded by Mr. Tomes might be helped on by extending their knowledge as Professor Roberts-Austen had done to alloys, by which they might find that things which were considered peculiar to amalgams might also be the common property of alloys. He had endeavoured to find a more full and accurate account of this the Bakerian lecture of the Royal Society, but it did not seem to have appeared at present in any scientific magazine.

Mr. H. Baldwin said this migration of metals, such as lead and gold, which were solid at ordinary temperatures,

seemed to make it almost certain that Mr. Amos Kirby's explanation of the alteration that amalgams underwent, was correct. Mr. Amos Kirby had always set down the alteration which took place in amalgam to a warpage and not necessarily to a contraction, the warpage being due to a re-arrangement of the mercury throughout the mass of amalgam; that is to say, he contended that where an amalgam was mixed with more mercury at one end of it, or at one portion of it, than at another, even after the amalgam had set the mercury would re-distribute itself evenly over the whole mass, and that the portions of the amalgam from which the mercury went would shrink, and those portions to which it went would expand, causing an alteration in shape which was sufficient to crack a glass tube and so forth, without necessarily any alteration in the specific gravity.

Mr. Reinhardt wished to ask a question as to the impress of the wire on the filling. Professor Black, when speaking about the flow of amalgam, ascribed it, as he understood, to crevices. He would ask Mr. Tomes whether there were any crevices in the filling on which he pressed the wire. Also as to the rapid setting amalgam he would ask if Mr. Tomes remembered that many years ago it was suggested that the proper way of using amalgam was to use it very dry, in a sort of powder, and pack it with hot instruments.

Mr. George Cunningham said in reading the excellent paper of Professor Black on this subject, they ought still to remember the wonderful work done by Mr. Kirby. Mr. Kirby had in his collection a very large number of experimental blocks of amalgam, and had been able, as Mr. Baldwin said, to prevent their contraction, to keep them straight, or to make them bend either one way or the other according to the distribution of mercury in the mass. The series of experiments were very interesting, and he called attention to them because it was a pity that Professor Black, in writing on the subject, appeared to be unaware of them. Since going into the matter with Mr. Kirby himself many years ago, he (Mr. Cunningham) certainly came to the

conclusion that it was advisable to adopt the Kirby method, and he had continued to do so ever since; first of all using an amalgam, the constituents of which he knew exactly, and further, always using it as far as possible under what might be termed scientific conditions, that was to say, as nearly as practicable always under the same conditions, a double tube mix of accurately weighed amounts of the alloy and mercury. With regard to the effect of heat on amalgams, the only point of interest he had to communicate was with regard to copper amalgam. He occasionally found it advisable to have a copper amalgam that would set quickly. This was done by mixing a certain proportion—about 5 per cent.—of precipitated silver with the mass. He found, however, after a time that the surface of such an amalgam filling became rough, owing to the formation of not temporary but permanent beads on the surface; and as there was no apparent advantage to be gained, he had discarded the addition of the precipitated silver. His colleague, Mr. Lennox, one day in discussing the matter suggested that there was a very much more simple way of attaining the desired result, viz., to take two masses of copper amalgam and raise them to two different temperatures, crushing them together in the mortar and mixing thoroughly; this certainly gave an amalgam which would set with considerable rapidity. On one point he thought Mr. Kirby would have to alter his mind, and that was as to warpage being evidence in favour of the so-called spheroiding of amalgam, although certain experiments that he (Mr. Cunningham) made some years ago in that direction had failed to convince him on that point. Under the advice of an expert he found the best way of testing a permanent level surface on fillings with various kinds of amalgams was by using them as mirrors and observing the reflections in them of parallel straight lines. There was not the slightest appearance of any curvature at any time, although the fillings referred to had been under observation for ten years, if not more. The question of the flow of the amalgam brought forward by Professor Black was of extreme interest from a practical point of view, and served, he thought, to

explain a great many of those bulging surfaces which were seen in certain forms of amalgam filling.

Mr. Paterson asked if the reference in the paper to the treatment of amalgam in a state of crystallisation might be repeated.

Mr. C. S. Tomes, in reply, said there were one or two things that had been suggested that he should like to add. Mr. Paterson suggested that he had hardly made his meaning sufficiently clear as to the desirability of burnishing the amalgam while it was setting and even after it had set, the idea being that that prevented crystallisation taking place, or at all events burnished down the crystals as they were forming, and so ensured a satisfactory surface. Mr. Cunningham pointed out that Professor Black had not quoted Mr. Kirby's researches. Dr. Black did not quote anybody's researches as a general rule. That was one of the faults of his paper that he started with the whole question *tabula rasa*, not only in respect to amalgams, but in respect to other things. As to amalgams taking on a spheroidal form, he (Mr. Tomes) never had believed in it and still less believed in it now. There was not the smallest evidence of a scientific kind in favour of the idea. He did not believe that crevices found at the sides of amalgam fillings were due to it in any way. They were due to the edges of the amalgams being brittle and to the amalgams not being in absolute apposition with the edges of the cavity when they were set, even if they were before. This was very likely due to the pushing out of crystals from the surfaces.

Mr. Cunningham also rather accepted Dr. Black's idea that the changes found in amalgams were due to "flow." The flow of amalgams was an extremely interesting thing, and bore very much upon the investigation of the subject, but he doubted whether it had anything to do with what happened in the mouth. The flow of an amalgam as far as they knew anything about it, was a thing which took place under very prolonged and considerable pressure, and he doubted very much whether results could be got by the intermittent influences happening in the mouth. It would be an interesting experiment to rig up some sort of

arrangement by which an amalgam could be subjected to intermittent and irregular pressure; but so far as any experiment as to flow had yet gone, he did not think there was any reason to suppose that it would happen in the mouth. They had been reminded of the old method of packing the amalgam with hot instruments. That was a very good method as far as it went. And what he had been doing lately pointed to its having been a better method than most others. They probably got in that way a very fairly rapid setting almost under the hand, and that was what they should aim at. The experiments to which Mr. F. J. Bennett alluded, made by Professor Roberts Austen, were exceedingly interesting, but they had not yet been published in a form in which one could make much use of them. Of course they pointed to Mr. Kirby's idea being right, that if an amalgam was irregular in its composition, and did contain in certain portions of its substance more mercury than it did in others, it would be extremely likely to re-arrange itself.

The thanks of the Society having been given to the readers of papers, the meeting adjourned.

Odontological Society of Great Britain.

ORDINARY MONTHLY MEETING

May 4, 1896.

MR. DAVID HEPBURN, L.D.S.Eng.

PRESIDENT, IN THE CHAIR.

THE Minutes of the previous meeting were read and confirmed.

The following gentlemen were elected as Auditors for the ensuing year:—Mr. NORTHCROFT and Mr. BATEMAN.

The following gentleman was proposed as a resident member of the Society:—ROBERT STEPHEN FAIRBANK, M.R.C.S.Eng., L.S.A.Lond., 18, George Street, Hanover Square, W.

The following gentlemen having signed the necessary obligation forms were admitted members of the Society:—THOMAS RUBERRY CHAMBERS, 29, New Inn Hall Street, Oxford; GEORGE HENRY BOWDEN, Roseneath, Reigate.

The LIBRARIAN reported that he had received the ordinary exchanges, and the usual Journals and Transactions.

CASUAL COMMUNICATIONS.

Mr. GEORGE BRUNTON read the following note on "Some Experiments in Colouring Porcelain for Teeth and Gum Bodies or Enamels":—

The porcelain which I have used for experiments is a low fusing one, the melting point is 1045° C.; this temperature

was determined by means of the Le Chatelier pyrometer. The analysis of the porcelain is as follows :—

Silica	65·44 per cent.
Alumina	4·57 ,,
Magnesia	2·26 ,,
Lime	13·52 ,,
Soda	9·96 ,,
Potash	0·66 ,,
Sulphuric Acid	0·53 ,,
Loss on ignition	1·66 ,,
Protoxide of iron	0·23 ,,
	98·83

Compare this with the analyses of the three porcelains, viz. : (1) Chinese ; (2) Berlin ; (3) English :—

	I.	II.	III.
Silica	71·04	72·96	39·88
Alumina	22·46	24·78	21·48
Lime	3·82	1·04	10·06
Bone earth	.. ..	.. ..	26·44
Alkalies	2·68	1·22	2·14

And with glass :—

	Window.	Crown.	Sheet.
Silica	69·0	67·7	56·0
Lime	12·5	9·9	
Alumina	7·4	1·4	1·0
Soda	11·1		
Potash	.. ..	21·0	8·6
Lead oxide	.. ..	.. ..	34·4

You will notice that the porcelain I have used is more like glass, and would be more correctly called an enamel. You know that "many varieties of glass, especially those containing relatively large quantities of silicate of lime and alumina, when heated for some time in the furnace become opaque, and are converted into a substance resembling porcelain."

I mention these facts to show clearly the material with which we are dealing. The ready way in which porcelain is coloured by the metallic chlorides led me to make some experiments with the combination of metals, the result of which is before you. Being dissatisfied with the imitation of gum in the low fusing body, I tried what I could produce in making a variety of shades. The gold chloride was a 2 per cent. solution, most of the others were 10 per cent. The metals which produce very little colour in the porcelain when used alone, seem to answer best the purpose of producing the delicate gradations of shade in pink gum. A rough and ready method was used in making those experiments. The porcelain powder was laid on a glass slab, and the liquid chloride mixed with it instead of water, and then at once put into a platina muffle and fired. The row of examples on the left of the card are produced by a single metallic chloride, that on the right by mixing the gold chloride with the chloride of the metal mentioned after each example in the first row. I have tried to produce a more natural gum by mixing a high fusing gum body with the low fusing plain uncoloured body, and have obtained the desired shade with metallic chlorides; the result, however, is that it raises the fusing point, and that is a drawback in using this mixture on a low fusing body. The high fusing gum which I have got the best results from (after trying many) is a gum enamel prepared by S. L. Close for Dr. J. Allens Body, using equal parts of the high and low fusing bodies. This work, as you see, is only in the experimental stage. I hope some one who has had more experience will try this method, and give us the result of his efforts.

Mr. Reinhardt asked Mr. Brunton if he had tried mixing

perchloride of tin and chloride of gold, and if that had had any effect whatever upon the shade of the gum colour. He thought also that some of the colours were altogether too dark, and for the guidance of his friends and others who might want to experiment in the matter, he would like it to be made clear what was the strength of the colouring solutions Mr. Brunton used.

Mr. G. Brunton said the gold chloride was a 2 per cent. solution and most of the others were 10 per cent. solutions. If the colours were seen by daylight it would be noticed that a mixture of tin with gold produced a slightly purple pink. If silver was mixed with gold, care should be taken to put only a very small quantity of silver, otherwise a strong yellow tinge would be obtained, and the same thing applied to zinc, cadmium, and the other metals which were used for white porcelain.

Mr. Brunton also showed a simple method of applying rubber dam by stretching it on a thin wire frame. The rubber was sewn on to a piece of calico, by which it was kept off the patient's face, somewhat like Fernald's rubber holder. It had only three fastenings and, beside being very light, the cloth was turned up so as to catch any gold which might drop during filling operations.

Mr. Oswald Fergus presented a framed photograph of "Long Calderwood," famous as the birthplace of William Hunter and John Hunter. He asked the Society to accept the picture because John Hunter's first published work was his article on the "Natural History of the Human Teeth," and when it was remembered that John Hunter had not the modern microscope to carry out his researches, they would feel a sense of wonder that he was able to do so much in the direction that he did.

The President said they were all extremely indebted to Mr. Fergus for his kindness.

Discussion on the Early Treatment of Crowded Mouths.

The discussion was opened by Mr. J. F. Colyer :—

Mr. President and Gentlemen,—In bringing the subject of "The Treatment of Crowded Mouths at an Early Age" under your notice to-night, I do so principally with the object of drawing your attention to a form of treatment which is, I think, but little practised, but which is, nevertheless, in my humble opinion, an extremely successful method to adopt in many cases. In referring to this subject, I do not propose to enter into the etiology of crowded mouths, which of itself is sufficient to form the theme of an interesting discussion. The first question I wish to lay before you to-night is this—Is it advisable to treat a crowded mouth directly such a condition in the future seems inevitable? Personally, I think the earlier the treatment of a crowded mouth is commenced the better; for as time progresses the irregular position of the teeth becomes more fixed and more aggravated, and hence the case is more difficult to treat. But there is, I think, a stronger argument than this, namely, that if room is made for each tooth as it erupts, the case by the time the succession of teeth is complete, simply resolves itself into the treatment of either a crowded-out canine or second bicuspid, whichever tooth happens to erupt last; while, if on the other hand, we leave the treatment of the crowding until the succession of teeth is complete, we shall have to deal with a condition in which probably the whole of the six front teeth are involved, and the correction of which would be long and tedious. Personally I see no argument whatever against treating a crowded mouth directly such a condition is recognised.

The next point worthy of discussion is—What are the relative advantages of treatment by *expansion and extraction?* In considering this question there are three points which should be clearly kept in mind :—(1) The great pre-

valency of dental caries; (2) The increasing tendency for the teeth to be lost at an early age through chronic periodontal mischief; (3) The fact that in the condition we are called upon to treat, nature is endeavouring to get sixteen teeth in the place where only fourteen, and in some cases twelve can be accommodated.

Now these points have the following bearings upon our treatment. They indicate—(1) That the method we adopt should tend, if possible, to reduce the tendency to dental caries; (2) That the movement of the teeth by mechanical methods should be avoided from these points of view—(i.) In teeth moved by mechanical means there seems to be a predisposition to chronic periodontal trouble; (ii.) All mechanical contrivances are liable to directly or indirectly cause caries of the teeth.

Let us now turn and see how expansion or extraction fulfil these objects. Taking expansion first, we find that it does not tend to reduce the liability to caries, for by this method the pressure of the adjacent teeth on one another is if anything increased, and, secondly expansion is a mechanical method, and the time during which plates have to be worn is somewhat considerable. There is also another point which is too frequently overlooked with expansion, namely, that the room gained is apparent and not real. A tooth when moved by mechanical means moves on its apex in a manner similar to the swing of a pendulum; in expansion we move a large number of teeth at once, forcing them in an outward direction. By this means the upper portion of the teeth, namely, the crowns, are made to occupy a greater arch, but the lower portion remain in practically the same crowded condition, hence the tendency for cases treated by expansion to relapse.

Another great disadvantage of expansion is to be found in the disarrangement of the bite which so frequently results, while in addition the very sloping direction into which the front teeth are often forced is decidedly unsightly.

Turning to extraction we find that (1) room is gained not only for the crowns, but also for the roots of the teeth. (2) The amount of mechanical treatment is lessened, and in

many cases abolished. (3) The pressure on the teeth is relieved, and a certain amount of isolation obtained—a condition conducive to the prevention of caries. (4) The bite is less disarranged than with expansion. (5) The teeth invariably assume a better direction. To sum up, it seems that crowded teeth should be treated as far as possible by extraction.

Taking for granted that early interference is called for in the treatment of crowded mouths, the next point I should like to suggest for discussion is this: On what lines should we proceed with cases that come under notice? For simplicity of description I propose to divide this question under two headings. (1) Those cases where the first permanent molars are unsaveable. (2) Those cases where the first permanent molars are capable of being saved.

(1) *Cases where the first permanent molars are unsaveable.*—In these cases I have found good results to follow from a line of treatment somewhat similar to the following: The first permanent molars are filled or treated in the best manner possible, so as to retain them until the second permanent molars have erupted. The crowding of the upper and lower incisors is then relieved by the removal of the four temporary canines. If the teeth erupt the normal way, the first and second bicuspids will come into a good position and we shall then have the following condition: the four incisors and the four bicuspids in a regular arch, with a greater or less space existing between the lateral incisor and the first bicuspids, so that the canine erupts just external to the arch; in other words, we shall have to deal with a fairly simple irregularity, namely, a canine high in the arch. To make room for the canines the first permanent molars should be removed directly the second permanent molars are fairly through the gum. A plate to hold back the second molars should then be inserted, this plate is made to cover the palate in such a way that it comes in contact with the palatal surfaces of the incisor teeth, while to the back of it are fixed half round gold wires which pass along the anterior surface of the second molars the plate being quite free of the bicuspids. This form of

plate is generally known as the Woodhouse plate and possesses this advantage: it retains the second molars in position, preventing them moving forward, while at the same time it allows the bicuspids to fall back, partly by the action of the bite and partly by the pressure of the canine tooth, so that many cases get quite well without any further mechanical treatment, a point of no small importance.

A line of treatment similar to that I have just indicated will naturally not be applicable to all cases, but it serves, I think, to illustrate the principle which we should adopt.

(2) *Cases where the first permanent molars are capable of being saved.*—This type of case is decidedly more satisfactory to deal with than the preceeding. Our treatment should in the first instance be directed to the first permanent molars, these teeth if necessary, being filled with fillings as permanent as possible. This accomplished space should be obtained by the removal of the unerupted first bicuspid. The operation consists in removing the deciduous first molar and then the bicuspid, and was first suggested by Mr. Tomes for the treatment of that irregularity of the lateral incisor where the mesial angle is tilted forward and directed towards the median line, and is, as you are aware, extremely difficult to correct if left until the permanent canine has erupted.

If a skull exhibiting this condition be examined, it will be noticed that the irregularity of the lateral is produced by the permanent canine pressing on the end of the root of the lateral. To relieve this pressure there is but one method available, namely, to remove the bicuspid and so allow the canine to fall back. It may be argued by some that extraction of the temporary canine would be sufficient to remedy the condition of the lateral, but if a dried specimen be carefully studied it will be noticed that the removal of the temporary canine will not have the desired effect of giving room for the permanent canine.

In the cases, the photographs of which I propose to throw upon the screen, the operation has been performed for the treatment of various types of crowded mouths, and

in one instance for the relief of what I considered to be a case of early superior protrusion. Of my nineteen cases I am able to show you twelve to-night, in the other seven I have been unable to retain trace of my patients.

In some of the cases the second bicuspids have not yet erupted, and such cases can hardly be said to be complete, but they are, I think, sufficiently advanced to show the effect of treatment. Before, however, placing these cases on the screen, it may be well to refer to the actual operation. First an anæsthetic should always be given, as the removal of the bicuspid is naturally attended by a good deal of pain, a point of great importance with children.

If we confine our attention to one side of the mouth at a time, nitrous oxide is quite sufficient, but if it is desirable to move both bicuspids at one sitting, then ether must be administered. The instrument I generally use for the removal of the teeth is a pair of Read's upper stump forceps with rather long blades. The temporary molar is first removed, and in attempting the extraction of the bicuspid the blades should be opened fairly wide; this is worthy of remembrance, for in my first cases I found a decided tendency not to keep them open sufficiently. The external blade, too, should be kept well outwards. It is well to advise the use of an antiseptic mouth-wash after removal, and if the extraction has been difficult, the wound should be syringed out several times a day.

(Mr. Colyer then showed, by means of lantern slides, twelve cases in which the treatment by removal of the unerupted bicuspid had been carried out.) In concluding his remarks he said :—

An analysis of these cases will show that whenever the operation has been performed for simple crowding, the result obtained has been good. In one case, although the irregularity of the lateral has been remedied, there seems to be too much room, and it is questionable if the bicuspid should have been removed. In another case the crowding would, I think, have been better treated by the removal of the laterals. In the case showing early signs of superior protrusion, the result is on the whole good, and I think

that in this class of irregularity the removal of the bicuspid at an early age is likely to be beneficial. Generally speaking, the form of treatment is a valuable one, and as time gives us experience we shall be able to better choose in what cases it can be best adopted.

In conclusion, I feel that I have done but scant justice to so important a subject as the treatment of crowded mouths; but to deal with it at all adequately would require much more time than we have at our disposal to-night. The principal points I should like to suggest for discussion are: (1) Is it advisable to treat a crowded mouth directly such a condition in the future becomes inevitable? (2) Which is the better form of treatment in the majority of cases, extraction or expansion? (3) In cases where the first permanent molars are saveable, is early removal of the first bicuspid a good method of treatment with the exception of those cases calling for extraction of the laterals? (4) In cases where the first permanent molars are unsaveable, what is the best plan of treatment? (5) In such cases, at what age should the first permanent molars be removed?

Mr. R. H. Woodhouse said he was particularly unsuited to criticise the chief feature of the paper, because he had never himself adopted the treatment that Mr. Colyer spoke of. The case that Mr. Colyer had brought forward he (Mr. Woodhouse) would be very unwilling to subject to any form of treatment for prospective irregularity. The longer he practised the more unwilling he was to interfere with mouths at a very early stage. He found that nature had such an immense power in correcting irregularities that appeared early, that he was willing to give her every chance. With the one exception of the lower teeth not biting inside the upper ones, he would not attempt to regulate any of the mouths that Mr. Colyer had thrown on the screen. With regard to the others, he (Mr. Woodhouse) did not think it was advisable to treat a crowded mouth directly such a condition seemed apparent, because he felt that it was impossible at such an early stage to say what the future of the mouth would be. It could not be really foreseen what teeth might become decayed in the course of

three or four years ; it must be at the best only conjecture. He thought that a great help had been afforded by the introduction of carborundum discs. Mouths that he would formerly have been very anxious about, now could be treated with much greater prospect of success by free divisions between the molars for incipient caries. He adopted that treatment with much greater heroism than he ever did before, because it could be done with much less suffering to the patient. By nursing a mouth up to say, the age of 14, they would be able to see what the future of the mouth was likely to be. He knew many cases in which he would have been tempted to sacrifice teeth, but the teeth had improved so much under treatment that he had left the mouth alone, and left the patient with unimpaired dentition. If they waited until 13 or 14, until all the teeth were fully erupted and in their places, they could then decide with much greater confidence what teeth it was best to sacrifice. With regard to the second question, he thought that if any treatment had to be adopted, extraction was generally the best. It was speedy, it saved the patient an immense deal of trouble, and it enabled them to meet a large number of cases that could not be met in any other way. They were all confronted with the difficulty of boys and girls attending school. If those boys and girls could come to them regularly they might be able to carry out the expansion treatment, but in a large number of cases that was quite impossible, and he was more and more inclined to adopt extraction as a remedy for crowded mouths. As to the third question, he had never yet adopted that treatment. He thought it was beginning too early for one thing, and although it might be done in hospital practice he would be shy of doing it in private practice. It seemed to him a little cruel to take out a temporary molar and thus sacrifice a good deal of masticating surface, and to take out a bicuspid and inflict a bad wound. He took it that the bicuspid would have to be taken out on both sides, so that it was needlessly putting patients to a severe operation. He thought the temporary teeth were very important to save for

masticating purposes. A great deal of constitutional trouble in the transition period, between losing the first teeth and gaining the second, was due to the want of masticating power, and they really lost the very centre of masticating strength by removing the temporary molars in the way suggested. The author had alluded to a plate for keeping back the second molars and pressing the back surfaces of the central incisors. He (Mr. Woodhouse) thought a good plan in adopting that plate was also to make pressure on the laterals, which were often placed far back, and if the upper teeth were kept back the lower teeth were at the same time kept from coming forward, because, if the articulation was perfect, as it should be, before such treatment was adopted, the molars would be prevented from tilting to any great extent. With regard to the fourth question, in cases where the first permanent molars were unsaveable, what was the best plan of treatment?—unhesitatingly he should say, take them out. If a mouth of 14 years of age needed thinning, he would probably take out the six-year molars; but in many cases he had deferred taking out the teeth to even later date. He thought they had to thank the new discs for saving many hundreds of molar teeth that must have gone when decay developed in that fatal place between the two molars. He felt that it was best to defer operations for irregularity till as late as possible; from 14 to 15 was quite early enough to take out teeth for the ordinary forms of irregularity. There might be exceptions, such as a hopelessly crowded mouth or a canine or lateral out of place, but as a broad principle he would never operate so early for the relief of crowding. Where early removal of the molars took place they would find the twelve-year-old molar canted over, so that when the wisdom teeth came, decay was very liable to develop between them and the molars. Therefore he thought it was most important that all the teeth should be firmly set in position before any operation was made for remedying irregularity.

Mr. H. Baldwin said the work Mr. Colyer had brought forward was just the sort of work which was required to

settle certain of the questions which were still *sub judice* in the mind of the profession. The profession had not really made up its mind as to whether it was better to extract unerupted bicuspids or not, and it had not made up its mind, in cases where six-year molars had to be extracted, whether it was better to extract them before the eruption of the twelve-year-old molars or after. He had been looking at Mr. Colyer's models, and he thought the results of the treatment in most cases were satisfactory. In those cases where Mr. Colyer thought he had got too much room, he (Mr. Baldwin) was inclined to think it was otherwise. The patients were still at a very early age, and in time those spaces would entirely close up. With regard to the second question, it depended very largely on the condition of the lower arch. If the case were one of general crowding of upper and lower it would certainly seem better to extract, and so put the teeth straight, but if the lower teeth seemed to be fairly regular and the upper teeth crowded, and at the same time the upper jaw distinctly contracted, showing the outer cusps of the upper bicuspids and molars internal to, or edge to edge with, the corresponding cusps of the lower teeth, that would seem to him a typical case for expansion of the upper jaw. Question No. 3 was one on which they would be glad to hear individual opinion. With regard to Question 5, personally he thought it was better to wait until the second molars were erupted, because then they got the full benefit of the extraction, got the full amount of room, and he did not think they got that same amount of tilting of the second lower molars that they otherwise would get. If the six-year molars were extracted very early a good deal of the space was frequently lost by the coming forward of the second molars. As to whether it were better to extract a saveable six-year molar or a bicuspid, it seemed to him that there were nearly a dozen reasons why the bicuspid should be chosen instead of the molar.

Mr. George Brunton said that his own experience coincided rather with that of Mr. Woodhouse, but Mr. Colyer's method, it must be remembered, was comparatively a new

one. He thought that most of the expansion plates capped the molars, but although he had made a good many expansion plates he only remembered having capped the molars once. He could generally manage to expand without doing so, thereby saving the teeth from premature decay.

Mr. Sidney Spokes said he should be content to say "No" to Mr. Colyer's first question. With regard to the second, speaking generally, he should say he was in favour of extraction as against expansion. The third question contained the crux of Mr. Colyer's communication. He would suggest to Mr. Colyer that in some of his cases if he wanted more room and felt obliged to do something, he might extract the temporary molars and leave the first bicuspid alone. In some of his cases it appeared that the extraction of the temporary molar alone would have given him quite sufficient room. The extraction of both the temporary molars would be another way out of the difficulty. The larger size of the temporary molars, compared with their successors, had not been referred to by Mr. Colyer, although no doubt the matter had occurred to him. In nearly every one of Mr. Colyer's cases there was an approach to a V-shaped arch. Was this the result of his treatment? In the case of the permanent canines he should leave them to become a case of outstanding canines, and deal with them at the usual period and in the usual way, taking into consideration the question of whether the first permanent molar had to be lost or whether the first bicuspid. He generally removed the first bicuspid if there were no other consideration than obtaining room for a canine. One of the strongest arguments that Mr. Colyer had brought forward for his treatment was with regard to the crowded condition of the teeth producing caries. They knew that that was one of the predisposing causes of caries, but at the same time he thought it was rather unusual, unless in a very severe case of neglect or of overcrowding, where the incisors were overlapping one another to a large extent, to find any great amount of caries amongst the incisors before the age 12, when the second permanent molar was coming up. He thought the two permanent molars should be left

to come in contact before the first permanent molars were removed, if they wanted to keep the space. Mr. Colyer had said that the case might be treated as soon as the second permanent molars appeared through the gum, but he (Mr. Spokes) would be disposed to wait a little longer and let the cusps interlock thoroughly. They would not then travel forward so quickly.

Mr. George Cunningham said he would like to tell the author of the paper that in the future it would not suffice to simply place before a scientific dental society the photographs of one aspect of the case. It was all very well to show the alteration in an upper arch, but that was only one view; the fundamental question of function—the nature of the articulation with the lower arch—had not been brought before them. He thought that was an important point which should not be lost sight of. He quite sympathised with the coming idea about the benefits derivable from the extraction of the unerupted bicuspid, though he had never yet had an opportunity of performing the operation. The author remarked in the paper that on a certain occasion, for certain purposes, he extracted the upper lateral incisors. In all his (Mr. Cunningham's) experience of cases of treatment of irregularity, he had never yet had to extract an upper lateral incisor, and he could not really understand how the author ever countenanced marring one of the main objects he evidently had in view, because he regarded the æsthetic function of that tooth as being extremely important. With regard to the author's first question, he would first ask him "Was it wise to employ the term a 'crowded mouth'"? As to the choice of treatment in the majority of cases, extraction or expansion, he supposed that by expansion the author meant a large regulating plate that covered the teeth. He thought there was a great deal in the newer methods, whereby means of bands and caps with attached springs or levers they could get rid of some of the objectionable features of the older methods. There was no doubt that the plate, especially when it was uncared for, led to disastrous results. He knew of one very serious case, where by using the ordinary expansion plate with piano

wire and vulcanite plate, he certainly produced innumerable points of caries about the teeth which he very much regretted. With regard to question three, it was evident that they must have some method of treatment, and any treatment which did not tend to keep the principle of the major factor of mastication in view, and the importance of the first permanent molar, was not worthy of consideration; therefore he rather endorsed what the author had said in his paper. As to question four, that was a question which nobody had settled. He had had a case which most men would have said, and he himself would have said so at one time, was one where the molars were unsaveable; but he had treated and capped with gold crowns those four molars instead of extracting them, and although it would be ten years before he would be able to tell definitely what the result of his operation was, yet in the meantime the case had been going on well and it was still full of hope. With regard to the author's fifth question, he (Mr. Cunningham) started with the idea of extraction when the second molars were coming up or just about to erupt; then he passed on to the other opinion that it was better to wait until the second molars were in thorough occlusion, which was the accepted practice; then came the split model stage of his career when he tried to look at the case not from the front or the outside but from the point of view from within. Notwithstanding the many authorities who had never repented taking out six-year molars, he had repented several, and was convinced that he might have done much better. In many cases they could not prevent a certain amount of tilting of the lower molar or the partial rotation of the upper molar. He was obliged to confess that the best cases he had seen where there was proper occlusion of second molars, had been where the first permanent molars had been extracted at the age of 9 and 10.

Mr. Robbins said he was surprised that Mr. Cunningham, with his vast experience, had never seen a case in which he was justified in removing a lateral tooth. He could show him some models in which he thought he had been more than justified in that form of treatment, and in which he

thought it was the only thing that could be done for the patient. They were all cases in which the mouth had been somewhat neglected. In one case the lateral had permanently locked inside the lower bite before he saw it, and the compression had been very great. The removal of the lateral gave a very good result indeed; the central and the canine came together without any apparatus and by just tipping off the canine teeth, he did not think a casual observer would notice it much in the mouth. With reference to the heroic treatment of Mr. Colyer's method, they always admired Mr. Colyer's heroism. A little while ago he (Mr. Robbins) performed the same operation, and in that one particular mouth he thought the result was fairly good. But on the whole he would like to strike the midway distance between Mr. Colyer and Mr. Woodhouse, and agreed with Mr. Woodhouse entirely as to the necessity of waiting until most of the teeth were well through. He should make the age 13 rather than 15 provided, as Mr. Woodhouse said, there were no instanding laterals to work upon. He gave parents three good reasons why they should not be in a hurry: first, it was generally a great inconvenience; secondly, it was a great expense to the parents; and thirdly, there was no doubt about it that a plate, if worn for any length of time, even though kept clean, did more or less injury to the permanent teeth.

Mr. Humby asked Mr. Colyer on what grounds he supposed that the apex of the root of a tooth was the centre of the circle from which the crown moved. He had come to a different conclusion. He thought, as Mr. Cunningham had mentioned, that in all the cases Mr. Colyer had shown one factor had been left out of consideration. He thought they limited their observation too much to the look of the model, that was to say, they saw the result that the surrounding conditions had on the dentition, but did not take into consideration the conditions themselves. He thought there were many surrounding conditions which modified considerably the eruption of the teeth, and it would be well if they were to consider what those conditions were. One condition which he found had never been touched upon in any of

the works on the articulation of teeth, was the effect of a thick, muscular, contractile lip upon a crowded dentition. There was another thing which would bring about the condition, viz., tonsillitis. He thought those two conditions were only the beginning of a long list that might be made up in connection with things they should consider with regard to crowded mouths. The size even of the tongue should be considered, because they were taught that the tongue formed the inner boundary and the lips the outer boundary. If that was the case they had to consider that an abnormally small tongue or abnormally thick lips would materially influence the question. There was another matter that he was very pleased to see one gentleman seemed to have met with in his practice, cases in relation to the tilting of the second permanent molar in consequence of the extraction of the first permanent molar. He himself had seen a considerable number of cases, and the cases where he had the most tilting had been with the late extractions. In late extraction the wisdom tooth had a greater forward pressure upon the second molar, and by extraction of the first they were taking away the forward support of the second molar after it was fully erupted. There was, in fact, nothing left whatever in support of the second permanent molar except the alveolus which bordered on the mesial aspect. He thought when the first permanent molar was taken away at an early age there was a greater quantity of tissue in advance of the second molar, and the leverage exerted from the advancement of the wisdom tooth was considerably less.

Mr. Denison Pedley said there was one point which had not been dealt with by the previous speakers, and that was with regard to the treatment that Mr. Colyer proposed of removing the first bicuspid with the temporary molar. It seemed to him that if any use was forthcoming for this operation it could be found in those extremely difficult cases of superior protrusion. In the last two days he had had two cases in which he had simply to reserve his opinion so far as the operation for extracting the first bicuspid and temporary molar was concerned. He did not know whether

it occurred to Mr. Colyer that occasionally the second bicuspid was absent. In cases of protrusion he might ask Mr. Colyer whether it was not advisable, in addition to removing the first bicuspid with a temporary molar, to raise the bite somewhat. His experience with protrusion was that in the majority of such cases the lower incisors pointed right inside, either on the necks of the centrals and laterals, or else the upper centrals were quite outside the bite.

Mr. Storer Bennett said that if he had known Mr. Colyer intended showing lantern slides, he would have brought down two slides which he thought would have been instructive. They were slides of a very valuable specimen contained in the Museum, and to which he would direct the attention of the members. It was a skull from which the outer alveolar plate had been removed on both sides. At some considerably anterior period to the time the owner died, the second temporary molar had been removed on one side of the mouth, but not on the other. They were, therefore, able to see what had been the result of the premature extraction of the second temporary molar on one side, and what had been the result of leaving it on the other. On the side where the second temporary molar had been extracted the first permanent molar had travelled forward, its roots had pressed on the unerupted bicuspids, and had driven them forwards, and they, in their turn, had driven forward the canine, so that the canine on that side of the mouth was over the situation of the lateral and pressing on its root. Had the second temporary molar been retained for its due time, the first temporary molar could not have so travelled forward. He would like to draw attention to a point he had never seen noted in the text books. If anyone would examine a skull of the age of 5 or 6 years, a skull from which the outer alveolar plate was removed, so as to display the roots of the second milk molars, it would be seen that they diverged to such an extent that the posterior roots extended further back than the posterior surface of their crowns. Therefore, they must have a very large influence in keeping back the six-year-old molars. With regard to the removal of six-year-old molars, he cor-

dially agreed with Mr. Woodhouse for two reasons, firstly, for the reason he had just given, and secondly because he thought one was too apt to forget that by taking out the six-year-old molars before the twelve-year-old molars were in position, all the biting came on the front teeth. He felt sure that was a very important factor in producing superior protrusion. That was a point Mr. Colyer had not touched on, and therefore was not now under discussion. With regard to the author's last question, he thought most distinctly they ought never to take out the six-year-old molars for the purpose of regulation until the twelve-year-old molars were so far erupted that they were in contact when the mouth was shut. He thought by leaving them until that time the bite was kept up and superior protrusion was far less apt to occur.

Mr. Storey said that until they had the Röntgen rays to help them in the matter they would be unable to settle the question, which necessarily in its treatment dealt with separate and individual cases. He had in his mind the cases of two sisters. One of them was brought to him with her mouth crowded when she was about 11 years old. He postponed on several occasions the anxiety of the parents to have the case dealt with, and when she was about 13 he treated the case by the extraction of the second bicuspids, and that treatment was exceedingly successful. The parents thought that what was good for one was good for another, and they kept the other sister from him until she was about 15 or 16 years old, and just now he had been obliged in consequence to take out the lateral incisors. With regard to the general course of treatment he had for a long time past been taking out the six-year molars when necessary at, roughly speaking, the age of 12, just before the occlusion of the twelve-year-old molars, and he had found in that way that he had got pretty good results with regard to regulation. He had also found that split models were of great help in the treatment of such cases by giving a more perfect idea of the articulation.

Mr. J. F. Colyer, in reply, said that as far as the form of treatment went, he was perfectly open-minded on the

question. He had used the treatment wherever he thought it advisable, simply and purely with the object of learning. He failed to see, unless that was done, how they were ever going to learn at all. With regard to irregularities of the teeth, they were, he thought, quite in the infancy of knowing anything about the subject; for instance, they had an insufficient knowledge of, what he might term the anatomy of irregularities, and he thought it was a subject which certainly someone should endeavour to elucidate. In the majority of crowded mouths the trouble was invariably due to the pressure of the canine, and the whole gist of the treatment seemed to be to find room for the canine. One speaker referred to the question of taking out a first temporary molar to obtain that room. If they would look at a skull they would find that by taking out the first temporary molar they did not give the permanent canine any room at all. The only way to make room for the permanent canine was by taking out the first bicuspid, and the permanent canine would then be able to move back and so relieve the pressure on and the irregularity of the lateral, a result which he did not think could be obtained if they waited until all the teeth were in position. Mr. Woodhouse said he would not treat a crowded mouth at an early stage. He (Mr. Colyer) would, for the older the patient becomes the more fixed become irregularities of the teeth and the less chance there is of getting them right. With regard to the free division between the molars, he held rather an opposite view. He endeavoured to avoid anything like a a space between the molars, and every day found the necessity of trying to contour; directly they began to leave space between the teeth they were simply inviting decay, and were likely to get periodontal mischief. With regard to the wound caused by the operation, that was not so bad as might be thought. If the patient were given an antiseptic mouthwash there would be very little after-pain. He disagreed with Mr. Woodhouse with regard to what he said about the value of the first temporary molar as the centre of mastication. He (Mr. Colyer) regarded the first permanent molar as the centre of mastication ; it was in the

very part of the jaw where the muscles played with the greatest power. As a matter of fact, he thought the first temporary molar, and in adults the first bicuspid, had really very little to do with mastication. With regard to Mr. Baldwin, it seemed to him that the whole question of whether they should expand an arch or not depended simply on the direction of the teeth. If the cusps of the teeth were sloping slightly inwards it was a case for expansion; if outwards he did not think expansion should be attempted. With regard to the six-year-old molar treatment, the only way to settle the question was by obtaining more information with regard to it. In answer to Mr. Spokes he would say, with regard to the temporary molar, that if Mr. Spokes would examine the skull he had mentioned he would come round to his (Mr. Colyer's) way of thinking. With regard to the V-shaped tendency, he thought it would be found that that tendency was marked also in the original models. He did not think there was any V-shaped tendency acquired in the operation. Where there was a V-shaped appearance afterwards they would find that tendency originally in the patient. He found when canines were erupted external to the arch they were by no means easy to bring into place. With regard to Mr. Cunningham, he really had not had sufficient time to get the cases ready, and should certainly like to have shown the lower models with the uppers. He knew Mr. Cunningham was very sweet on the question of the function in mastication, but the aim and object of regulation was not to produce a perfect bite. Directly they attempted to do that they left out the question of the tendency of the teeth to decay, and he thought that was the principal thing they had to fight against. He would ask Mr. Cunningham how he was going to treat a case of a canine erupted over the lateral, with the lateral internal to the bite?

Mr. Colyer said another sweeping statement had been made by Mr. Cunningham about the first permanent molars. There were many cases that came to them where it was absolutely necessary to take out a decayed molar, for instance, where first permanent molars were decayed

below the gum, and causing chronic periodontitis. With regard to Mr. Humby, he would say he had never yet seen a tooth moved by mechanical means where the tooth moved bodily. The tooth seemed to swing on its apex. With regard to lip action on the teeth he thought that was well known, but he did not think that tonsillitis had anything whatever to do with causing irregularities. It was argued that by tonsillitis and by the mouth breathing that it gave rise to, the mouth was kept open and the buccinator muscle pressed on the bicuspids. Against that argument they had to consider the following facts : the buccinator muscle lay along the surface of the molar teeth, and the saddle-shaped arch was not in all cases symmetrical. If they put their finger into a child's mouth they would not find any more pressure in the region of the bicuspid than in the region of the molar teeth. If the saddle-shaped arch were due to the pressure of the buccinator one would expect to find more pressure certainly on placing the finger in the mouth. The majority of saddle-shaped arches could be accounted for by crowding. In reply to Mr. Storer Bennett, he would say that to take out a second temporary molar at an early age in a child's mouth was a fatal form of treatment, but he did not think the extraction of a first temporary molar had the same effect—he failed to find the second temporary molar moving forward. That was what he expected to find but he had failed to do so. With regard to Mr. Storey, he quite agreed with him in thinking that the X rays might be brought into use.

A vote of thanks having been accorded to those who had brought forward casual communications and contributed to the discussion, the meeting was adjourned.

Odontological Society of Great Britain.

ORDINARY MONTHLY MEETING.

June 1, 1896.

MR. DAVID HEPBURN, L.D.S.ENG.

PRESIDENT, IN THE CHAIR.

THE SECRETARY read the Minutes of the last meeting which were confirmed.

Messrs. BADCOCK and BRUNTON were appointed scrutineers for the ballot.

The following gentleman was elected a member of the Society:—CHARLES SYDNEY PRIDEAUX, L.D.S.Eng., Dorchester, Dorset.

The TREASURER (Mr. Hutchinson), in presenting his annual report, said, that it was with great regret, that he felt unable any longer, to discharge his duties, on account of the pressure on his time, and he therefore deemed it best to resign, as he could not hold any office which he could not fill to the best of his ability. He desired to thank the large majority of the members, for the kind way in which they had fulfilled their obligations, and this had much lightened his labours, but to a few, whom he had to remind of their debts, he would say that as the subscriptions were due in advance, according to the byelaws, those debts were "debts of honour," and so could only be dealt with by occasional reminders! In handing over his duties to his successor he

Odontological Society's Accounts for the Year November 1st, 1894, to October 31st, 1895.

Dr.	£	s.	d.
To Annual Subscriptions	508	4	0
,, Arrears	61	19	0
,, Entrance Fees	53	11	0
,, Sale of Transactions, &c.	25	4	5
	£648	18	5

Cr.		£	s.	d.	£	s.	d.
By Rent					150	0	0
,, Fire Insurance					3	7	3
,, Meetings.	Baker—Hire of Microscopes	4	15	0			
	Bale—Notices, Postages, &c.	21	5	1			
	Reed—Reporting	16	16	0			
	Camps—Refreshments	21	17	11			
					64	14	0
,, Library.	Lewis—Periodicals	1	6	0			
	Camps—Sub-Librarian	5	5	0			
	Thomas—Sub-Librarian	17	3	1			
	Thomas—Binding and Petty Expenses	4	3	7			
					27	17	8
,, Museum.	Ebbs—Attendance	14	17	0			
	Bailey—Glass Shade	1	5	6			
					16	2	6
,, Transactions.	Bale & Sons—Printing, &c.	124	8	0			
	Dellagana—Illustrations	2	0	0			
					126	8	0
,, General.	Bale — Notices, Postages of Transactions, Stationery, and General Printing, &c.	53	18	2			
	Treasurer—Postages and Petty Expenses	4	12	0			
	Secretary—Postages and Petty Expenses	3	8	10			
	Bank Charges	0	3	7			
	Camps—Gratuity	5	5	0			
	Brown & Son—Accountants	5	5	0			
					72	12	7
					£461	2	0

	£	s.	d.
Balance at Bank, October 31st, 1894	156	15	5
Gross Receipts, November 1st, 1894, to October 31st, 1895	648	18	5
	£805	13	10

	£	s.	d.
Gross Expenditure, November 1st, 1894, to October 31st, 1895	461	2	0
Consols Purchased, February 9th, £150, costing	156	19	9
Consuls Purchased, May 17th, 1895, £60, costing	63	10	0
Balance at Bank, 31st October, 1895	124	2	1
	£805	13	10

	£	s.	d.
Gross Receipts for the year, November 1st, 1894, to October 31st, 1895 ..	648	18	5
Gross Expenditure ,, ,, ,, ,, ,, ..	461	2	0
Surplus of Receipts over Expenditure	£187	16	5

INVESTMENT ACCOUNT.

	£	s.	d.
Amount of £2 15s. % Consols, October 31st, 1894	3767	13	9
Purchase of £2 15s. %, February 9th and May 17th, 1895, £210, costing £220 9s. 9d.	210	0	0
Dividends, January, April, July and October, 1895, £104 18s. 4d., invested, producing	98	8	7
Amount of £2 15s. % Consols, at October 31st, 1895	£4076	2	4

We have made up the above accounts from the books and vouchers of the Society, and certify them to be correct.

HENRY BROWN & SON, *Chartered Accountants*,
13, Victoria Street, London, S.W.

G. W. BATEMAN,
G. NORTHCROFT, } *Honorary Auditors.*

was sure that Mr. Woodruff would merit the entire confidence of the Society.

There was a very handsome amount invested in Consols, but as the future arrangements of the Society, as to its habitat, were very uncertain, this sum must not be encroached upon, as it would probably be wanted to secure a permanent home; and as it had been so jealously guarded, and so carefully accumulated by his predecessor, Mr. T. A. Rogers, he trusted the members would do all in their power to maintain and increase it.

In conclusion, he thanked the Council and the Society for their great kindness and consideration during his term of office.

Mr. W. A. Maggs (Librarian) reported the receipt of nineteen bound volumes of the *Transactions of the Clinical Society*, 1878 to 1893, from Mr. Storer Bennett, in addition to the usual periodicals and exchanges.

He then presented his annual report. He said the list of exchanges had been slightly increased during the past year, and it now included the following periodicals and journals: — *Bristol Medico-Chirurgical Journal, British Dental Association Journal, British Journal of Dental Science, British Medical Journal, Dental Hospital of London Students' Society's Transactions, Dental Record, Dominion Dental Journal, German Odontological Society, Guy's Hospital Gazette, Guy's Hospital Reports, International Dental Journal, Lancet, Medical Society of London Transactions, National Dental Hospital Students' Society's Transactions, Proceedings of Royal Dublin Society, Royal Institution of Great Britain, Royal Medical and Chirurgical Society, Royal Society of London, Smithsonian Institute.*

The *Transactions* were presented to the libraries of the Royal Colleges of Physicians and Surgeons, and to the University of Berlin.

The Society had continued to subscribe for *The Dental Cosmos, Journal of Anatomy and Physiology, Journal of Pathology and Bacteriology.*

The following periodicals were sent gratuitously, and

were gratefully acknowledged :—*Chicago Dental Review*, *Journal of the Pharmaceutical Society*.

He stated the sub-librarian had continued in attendance on Mondays and Fridays, from 6.45 p.m. to 8.45 p.m., and at these times the library had been used as a reading-room. Books could be borrowed on the above-named evenings, or at any other time by written application, in which case the books were left with the hospital Porter. The number of members who had made use of the library for reading purposes during the year, from June 1, 1895, to May, 31, 1896, had been thirty-two, and the number of visitors during the same period forty-two. The actual number may have been exceeded, but members and students had signed the attendance book as stated. The number of books borrowed — a privilege now confined to members only—during the year was forty-four, as compared with ninty-two for the preceeding eighteen months.

He concluded the report, which he ventured to think satisfactory, by saying he would be glad to receive any suggestions from members. He referred to the fact that a book was on the library table in which the name of any book wanted might be entered, and it was needless to affirm, the Council usually accepted with pleasure such recommendations.

Mr. Storer Bennett (Curator) in presenting his monthly report said : I have to present to the Society this evening, two specimens of comparative dental pathology, presented by Mr. Morton Smale, to whom we are indebted for so many valuable contributions to our Museum in this particular sphere. The first is the skull of a female gorilla, showing on the inner side of the mandible a certain amount of absorption in the alveolus which one might look upon as a somewhat early stage of pyorrhœa alveolaris, but as we have only the bones to go by, it is difficult to be quite certain that such is really the cause of the condition seen. As a matter of fact the bone on the inner side of the mandible does show very much the appearance that one gets in a certain stage of pyorrhœa alveolaris. The other

specimen which Mr. Smale has presented is also that of a female gorilla. There has been a loss on one side of two molars with a very large cavity of absorption of the alveolus, and on the other side the first and second molars have been lost. The loss of bone on the right side is very considerable. These specimens are both of them interesting, because, as gorillas have never been kept in captivity, the cause of the condition cannot be put down to the animal being kept in confinement. I may say also that in this specimen there is a tilting of the right lower premolar, the result of the loss of the first and second molars, which of course suggests to one's mind that early extraction had been performed.

With regard to the work of the Museum for the year, I think the number of contributions, although less than I had to record this time last year, are satisfactory. There are thirty-nine, last year at this time they were forty-seven. But it is only fair to remember that we are now dating for twelve months, whereas previously we had to deal with seventeen months, the annual meeting having been changed from January to June. The number of visitors who have been in the Museum during the last twelve months have been thirty-nine, nine of them being members of the Society and thirty of them visitors. Last year we had thirty-six visitors and seven members. Therefore, we have I think, a very fair average attendance during the year, although I must say I wish more members would take an interest in the Museum, and visit it on the three nights a week it is open for two hours. There is a sub-curator in attendance to point out any specimen which a person may wish to examine, and to give any directions as to what kind of specimens we have or where they are to be found. Therefore I am sure that members and other visitors would be repaid if they would take the trouble to come to the Museum sometimes during the year.

Following the precedent of former years, I have placed on the table all those specimens given to the Museum during the last twelve months, and I think they illustrate a very fair range of subjects of comparative, as well as human

pathology, and if the Museum progresses as satisfactorily in the future as it has done during the past, I am sure we shall all be proud of being in possession of a perfectly unique collection, such as is not in any way rivalled by any other Museum with which I am acquainted. We have absolutely no rival at present in the field we occupy.

Casual Communication.

Mr. Boyd Wallis exhibited a tray for annealing gold for filling purposes, heated by electricity. The lamp was one of very low elevation and convenient shape which had been specially prepared for him by Messrs. Edison and Swan, a 100 volt lamp of 32 candle power. He found that method of annealing especially useful in connection with sponge gold. As showing the power of the lamp, he stated that water could be boiled in about twelve or fifteen minutes; he had had one of such lamps in use for the last two or three years.

Paper "On some Points in connection with the Bacteria of the Mouth," by Dr. Washbourn and Mr. Goadby.

Some Points in Connection with the Bacteria of the Mouth.

By J. W. Washbourn, M.D., F.R.C.P., and
K. W. Goadby.

A knowledge of the nature and functions of the bacteria found in the mouth is of the greatest importance both to dental surgeons and to medical men. To the dental surgeon it is of importance on account of the *rôle* played by bacteria in the production of caries and of various local affections, while to the medical man it is of importance in the study of the etiology of many infective processes, such for instance as diphtheria or scarlet fever.

We have been especially interested in the relation of the streptococci found in the mouth to those occurring in septicæmic conditions in the human subject. We have made a number of observations in this connection, and we venture, with some diffidence, on account of their incomplete nature, to bring our results before you to-night.

In the course of our investigations we have

examined the mouths of a large number of healthy and sick individuals, so that we have obtained a fairly extensive practical knowledge of the bacteria of the mouth.

Anyone who has studied this question will be struck with certain facts. In the first place bacteria are found in all mouths, whether the teeth are sound or carious, and whether the individual is well or ill. Secondly, when the teeth are carious, there are generally many more bacteria present in the mouth than when the teeth are sound. Thirdly, in acute diseases more bacteria are present than in health. Lastly, a systematic cleansing of the teeth with the tooth-brush greatly diminishes the number of the bacteria present. An example which came under our notice well illustrated this point. We made a series of examinations of the mouth of a boy with sound teeth, on account of the number of spirilla which were constantly present. One day, to our surprise, the spirilla had completely disappeared, and on enquiry it turned out that the boy had taken to the use of a toothbrush, as he was getting tired of the repeated examinations.

Cleansing of the mouth diminishes the number of bacteria, partly mechanically, and partly by removing *débris* of food and dead epithelial cells upon which the bacteria flourish. All the con-

ditions which favour the retention of particles of food, such for instance as a close packing of the teeth, also favour the growth of bacteria.

An overgrowth of bacteria in the mouth is checked by certain natural processes. Firstly, the saliva acts not only by mechanically removing the bacteria, but also in virtue of its bactericidal properties. Sanarelli has shown that fresh saliva destroys some bacteria and hinders the growth of others. In this respect it is similar to the blood serum and to other fluids of the body. Secondly, the cells which are contained in the lymphoid tissue of the tonsils, act as phagocytes englobing and destroying bacteria.

The importance of diminishing the number of bacteria in the mouth is due to the undoubted fact that caries is caused by their agency. It is well known that caries occurs most frequently in those who neglect their teeth. There are no doubt other causes which favour the production of caries, such as an imperfect development of the teeth, a deficient calcification and so on; but these are only predisposing causes, and without the agency of bacteria caries does not occur.

The exact manner in which caries is produced appears to be the following:—Bacteria multiply in various parts of the teeth where cracks or irregularities allow of the collection of particles of food. During their growth acid is formed and

a decalcification takes place. The organic matrix of the tooth thus becomes exposed, and then serves as food for the bacteria; and a further formation of acid occurs, which again decalcifies fresh portions of the tooth. The bacteria penetrate into the healthy structure through the dentinal tubes, and produce a lateral destruction of the elastin walls of the tubes and ultimately of the surrounding tissue, so that a large cavity may be formed with only a small external opening. Should the pulp cavity be reached, inflammation occurs and suppuration may ensue.

Caries must not be considered a specific process due to only one kind of bacterium. There are many species of bacteria which will produce caries, just as there are many kinds of bacteria which will produce inflammation and suppuration in various parts of the body.

We should only weary you by attempting to give a list of the species of bacteria that have been found in the mouth at one time or another by different observers. Many of these bacteria are only occasional visitors which have been introduced with the food or air. They remain for a short time in the mouth and then disappear, the conditions not being favourable for their development. When we consider the large number of species of bacteria contained in ordinary drinking water, it is no cause for surprise that syste-

matic cultivations made from the mouth reveal the presence of many kinds of bacteria.

But apart from the bacteria that are, so to speak, accidentally present, the mouth contains certain species which constitute its normal flora. Some of the constant inhabitants of the mouth appear to be incapable of multiplying outside the body under the ordinary conditions of nature, and indeed some species have resisted all attempts at cultivation in artificial media. Some, on the other hand, can be cultivated in the various media generally employed.

On examining the different regions of the mouth certain species of bacteria are met with most frequently in certain localities. This localisation is most apparent when the teeth are sound and the mouth systematically cleansed.

Scrapings from the mucous membrane of the cheek, especially in the region of the buccal sulcus, invariably show the presence of cocci generally arranged in pairs and often adherent to epithelial cells (*vide* fig. 1). In perfectly healthy mouths, these are often the only kind of bacteria seen on a microscopical examination. We shall refer to these cocci hereafter. Sarcinæ are often present in this region in unclean mouths and when the teeth are carious.

The space between the gums and teeth is a favourite spot for the growth of bacteria. Those

which are most constantly present cannot be cultivated upon ordinary media. We believe that this is partially due to the fact that they are anäerobic, for under anäerobic conditions we have obtained a growth of several species, but we have unfortunately not yet obtained pure cultivations. The species to which we refer are leptothrix innominata, bacillus maximus buccalis, jodococcus vaginatus, spirillum sputigenum, spirochæte dentium.

The *leptothrix innominata* consists of fine interlaced threads, forming felted masses (*vide* fig. 2). It is probably pleomorphous, and it is possible that it represents more than one species.

The *bacillus maximus buccalis* consist of large jointed bacilli, which stain of a purple colour with iodine and lactic acid (*vide* fig. 3).

The *spirolum sputigenum* consists of curved rods, which when examined in the hanging drop are motile. Some interest attaches to this bacillus, because it was formerly considered by some observers to be identical with the cholera vibrio. Its inability to grow on ordinary culture media at once distinguishes it from the latter micro-organism (*vide* fig. 4).

The *spirochæte dentium* consists of very fine corkscrew-shaped bodies slightly pointed at the ends, and staining faintly with the aniline dyes (*vide* fig. 5). This spirillum looks very much

like the flagella seen upon other bacteria. Indeed, we are still uncertain whether some of the spirilla forms met with in the mouth are not really flagella. In some of our specimens the fine spirilla appear to be attached to the spirillum sputigenum. By examining hanging drop preparations we are, however, quite satisfied that most of the fine spirilla forms are really bacteria, for they can be observed to possess independent motility. Similar fine spirilla have also been found in the evacuation of patients suffering from cholera, and in the intestinal contents of pigs. The spirochæte dentium was found by Netter in the pus from a case of putrid empyema.

We have isolated a bacillus which agrees in its microscopical appearances with that described by Miller as the *leptothrix buccalis maxima*, and which differs from the bacillus buccalis maxima in not staining with iodine and lactic acid.

Various chromogenic bacteria have been found in the mouth. Freund isolated eighteen different species. These bacteria are interesting because they are the cause of various pigments which occur upon healthy and carious teeth and on deposits of tartar.

Pathogenic Bacteria in the Mouth.—We now come to the interesting question of the presence of bacteria pathogenic to the human subject in the mouths of healthy individuals.

There is abundant proof that such an occurence is by no means uncommon. The *diplococcus of pneumonia* has been found in a large number of the cases in which it has been searched for. The best method of isolating it is to inoculate mice with saliva and to make cultivations from the blood after death. This micro-organism is the cause of acute lobar pneumonia and of some forms of pleurisy, cerebro-spinal meningitis, otitis, and other diseases in the human subject.

The *diphtheria bacillus* has also been found in certain cases. On several occasions one of the authors has found virulent diphtheria bacilli in the mouths of perfectly healthy individuals, or in patients convalescent from scarlet fever and with no symptoms of diphtheria. In one case it was present for several weeks in the mouth of a healthy individual.

Among the pathogenic bacteria that have been found from time to time in the mouths of healthy individuals, we may mention the staphylococcus pyogenes aureus and the streptococcus pyogenes; to the latter we shall presently revert.

The occurrence of pathogenic bacteria in the mouth is of great interest. It throws light upon the spread of disease, and shows how an apparently healthy individual may convey disease to another. This is one of the modes by which diphtheria is disseminated, and it is on this

account that we meet with difficulties in attempting to eradicate the disease when it has once gained a foothold in an institution such as a large school. It, moreover, shows how carefully dental instruments should be disinfected after use. We cannot help feeling that sometimes sufficient care is not observed in this direction. It is not sufficient to rinse instruments in an antiseptic solution; they should, if possible, be placed for a few minutes in boiling water, there being no better way of sterilising than this simple procedure.

But apart from these practical considerations, there is the theoretical question how a virulent bacterium can remain in the mouth without producing disease. This is, without doubt, due to the individual being immune. A bacterium only becomes pathogenic when it is virulent in relation to the susceptibility of the individual. The same bacterium may be harmless to one individual and yet produce disease in another. For the production of disease two factors are necessary—the exciting and the predisposing cause. The former, in infective diseases, is the bacterium, and the latter the susceptibility of the individual. If the individual is not susceptible no disease is produced, and different persons vary in respect to susceptibility.

We will now discuss the question of the pre-

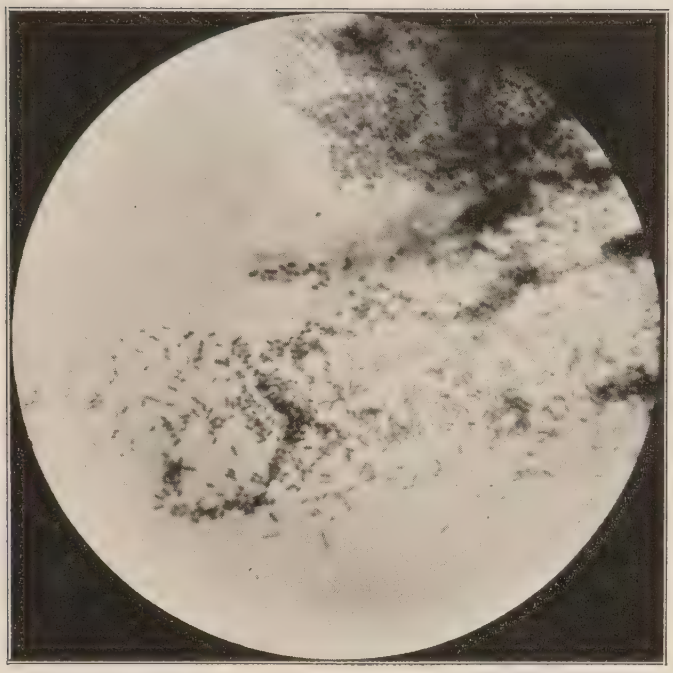


Fig. 1.

Diplococci in and around epithelial cell from normal healthy mouth (direct) × 1,500.

(Outline of cell not very distinctly shown.)

Fig. 3.

Bacillus maximus buccalis from healthy mouth (direct) × 1,000.

Fig. 4.

Spirillum Sputigenum from healthy mouth (direct) × 1,000.

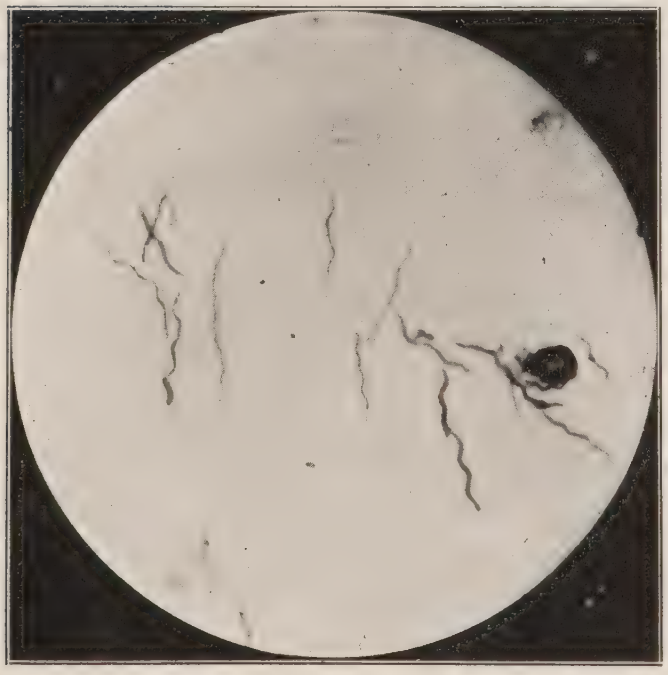
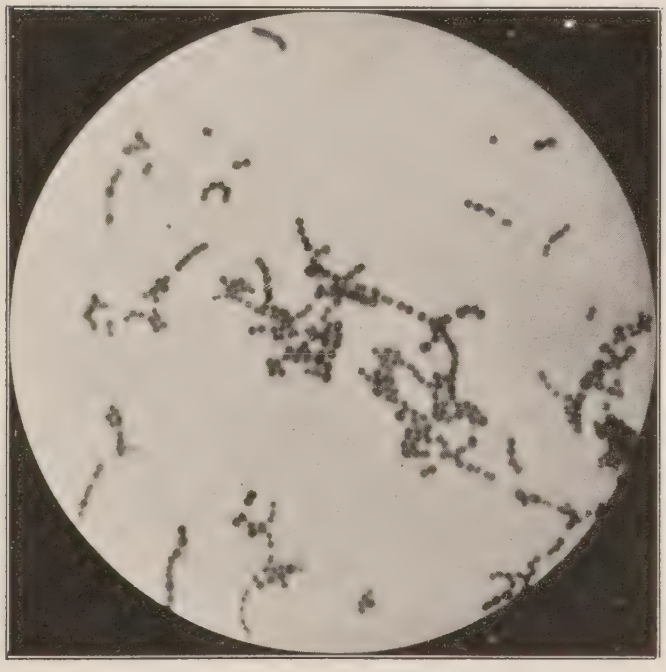


Fig. 5.

Spirochæta Dentium from healthy mouth (direct) × 1,000.

Streptococcus brevis from healthy mouth (cultivation) × 1,000.

See p. 252.



Streptococcus longus from fatal case of Pyæmia (cultivation) × 1,000.

See p. 258.

NOTE.—The reference to *Leptothrix innominata* (p. 247, fig. 2) must be ignored, as this figure has not been reproduced.

sence of *pathogenic streptococci* in the mouth. The evidence is conflicting; some observers state that pathogenic streptococci are frequently present, others say they are seldom present; while a third series of observers maintain that a streptococcus is commonly found in the mouth which is non-pathogenic, and which is a different species to the pathogenic streptococcus.

We have made a number of observations in this direction. On making microscopical examinations of the secretion from various regions of the mouth, we have been struck with the frequent presence of masses of cocci. They are generally to be found on the tonsils and gum margin, and invariably on the mucous membrane of the buccal sulcus. We have found them present in the mouths of eighteen healthy individuals we have examined. These cocci are often found lying upon squamous epithelial cells (*vide* fig. 1), as a rule they are arranged in the form of diplococci, but sometimes short chains are to be seen. The individual cocci may be elongated, giving the appearance of short bacilli. Now by making cultivations from the buccal sulcus where these cocci are always present we have invariably obtained cultivations of streptococci, which we have no doubt are the same as those seen in the microscopical preparations. That the cocci are arranged chiefly in pairs in the mouth and in

chains in the cultivations is quite consistent with what we know of the morphology of streptococci.

The method we adopted is the following: A little of the scraping of the mucous membrane was removed with a platinum wire, and broth tubes were inoculated and incubated at 31° C. for twenty-four hours. At the end of this time the broth examined microscopically showed a growth consisting of diplococci, streptococci, and other bacteria. From the broth, streak cultures were made on agar. Sometimes the resulting growth was a pure cultivation of streptococci, but generally other colonies also appeared; among these the most frequent were large crenated colonies of sarcinæ, especially in those cases in which a large amount of caries existed. Having obtained a cultivation on agar, pure cultivations could easily be obtained by inoculating a third series of agar tubes.

We have examined 24 mouths in all, 16 with perfectly sound teeth, and 8 with one or more carious teeth, and in every case streptococci were obtained in the cultivations. These observations show quite conclusively that streptococci are invariably present in the mouths of healthy individuals, they also show what care must be taken in coming to conclusions as to the significacation of streptococci found in the mouth in disease. Many observers, in making bacterio-

logical examinations of the exudation in diphtheria, lay great stress upon the presence of streptococci, in addition to the diphtheria bacillus in the cultivation tubes, and they state that when many streptococci develop in the cultures the case is more severe than when the diphtheria bacillus only is present. Drs. Goodall, Card, and one of the authors have doubted this from their own observations; and the fact that streptococci are present in the normal mouth gives an explanation of these divergent results.

An exceedingly important question arises with regard to the relation of the streptococci found in the normal mouth to the streptococcus which is the cause of disease in the human subject. Is the streptococcus of the normal mouth a harmless saphrophyte, which is only related to the streptococcus of disease by certain similarities, just as the hay bacillus resembles the anthrax bacillus? Or are the two micro-organisms varieties of the same species, which are capable under appropriate conditions of being mutually convertible? Can the normal streptococci of the mouth invade the body and produce disease under circumstances which lower the resistance of the body?

We will give a few examples to make these questions quite clear. In scarlet fever streptococci often invade the tissues of the tonsil, and may spread to the other tissues of the body,

producing septicæmia or pyæmia. The streptococci cultivated from the resulting lesions are quite similar to the streptococci found in other septicæmic conditions, and possess a similar virulence when tested upon animals. It is a very enticing theory that the normal streptococci in the mouth have been enabled to invade the tissue of the body in virtue of the lowering of the resistance caused by the virus of scarlet fever, and that in their passage through the body they have increased in virulence. A similar example may be given in the case of puerperal fever, which is due to the invasion of the body by streptococci. Now in the normal vagina streptococci are frequently present, and it is suggested that the lowering of resistance of the body during parturition has enabled these streptococci to invade the body, that, in fact, a process of auto-infection has occurred. Such a view must be accepted with the greatest caution, on account of the bearing it has upon our views of the etiology and prophylaxis of infective diseases. It certainly does not agree with our knowledge of the etiology of puerperal fever, for this disease is generally conveyed by the introduction of micro-organisms from the outside, by means of infected instruments, or the hands of the operator. The etiology of scarlet fever is also opposed to the same view.

Besides, wounds of the mouth heal very rapidly,

and this we should hardly expect if the ordinary mouth streptococcus were identical with that of disease. On the other hand, operations about the mouth may be followed by a streptococcal pyæmia. A case of this kind was under the care of one of the authors. The extraction of a tooth was followed by signs of acute septicæmia, the patient only recovering after necrosis of the alveolus of the upper jaw. Such cases may be explained on the auto-infection theory just mentioned, but another explanation is possible. Virulent streptococci may have been introduced from the outside by infected instruments, or they may have been accidentally present in the mouth.

We have already alluded to the occasional presence of virulent diphtheria bacilli in the mouth, and there is no doubt that virulent streptococci are also at times present. Several observers have undoubtedly found virulent streptococci in the mouths of healthy individuals, but this does not prove that the streptococci constantly present in the mouth are of this nature.

Our own observations have led us to incline to the view of Lingelsheim, that the normal streptococcus of the mouth is a different species to that which produces disease in the human subject.

The question is an exceedingly difficult one to decide, and an analogous question arises in the case of cholera and diphtheria. Are the vibrios

met with in drinking water different species from the cholera vibrio? and are the Xerosis bacillus and Hoffman's bacillus different species to the true diphtheria bacillus.

We will say a few words about the relation of Hoffman's bacillus to the diphtheria bacillus, for we believe the question to be somewhat analogous to that concerning the streptococcus. Hoffman's bacillus is not infrequently found in normal mouths, and has no doubt in many instances been mistaken for the true diphtheria bacillus. It resembles it in cultivations and to some extent microscopically, especially in old cultivations, when it may become clubbed like the diphtheria bacillus. It is not, however, pathogenic to animals, and can be distinguished from the diphtheria bacillus by the careful comparison of cultures made under similar conditions. It has never been converted into the true diphtheria bacillus by artificial means and is probably a different species, belonging, however, to the same group. We have already stated that the true pathogenic diphtheria bacillus may be present in the mouths of healthy individuals.

Now to understand the difficulties in distinguishing the normal streptococcus of the mouth from that of disease, we must say something of the varieties of streptococci found in various diseases in the human subject. Streptococci are

the cause of erysipelas, pyæmia, puerperal fever, and a variety of other septic affections. The streptococci obtained from different cases of these diseases agree with one another in their main features and have been grouped together by Lingelsheim into one species, called by him the streptococcus longus.

The general characters of this streptococcus are the following : It grows best at 37° C., but will grow at the ordinary temperature of the air. On agar and gelatine the colonies are minute and semi-transparent, the latter medium is not liquefied. The growth in broth is rather characteristic; flocculent masses stick to the sides and fall to the bottom of the tube, while the rest of the broth remains clear and transparent. A slight amount of acidity is produced in the cultivations. The microscopical appearance of the broth cultivations is characterised by the length of the chains, some consisting of as many as forty members. Hence the name streptococcus longus. In other media the chains are often much shorter, and in the tissues of infected animals only diplococci forms may be met with.

These are the main characters of the streptococcus longus, but cultural and microscopical differences are to be observed in the micro-organisms obtained from different sources. For example, broth may be rendered uniformly

turbid, instead of presenting the characteristic growth above described. Differences in virulence in animals have, however, been looked upon as the most important point of distinction between pathogenic streptococci obtained from different sources. The streptococcus of erysipelas has been distinguished from the streptococcus pyogenes by being more virulent to rabbits than to mice.

The test of virulence is, however, very fallacious, as will be shown by the following experiments. We obtained streptococci from the following sources: (1) A case of suppurating knee joint in a man; (2) a fatal case of pyæmia in a child; (3) a severe case of phlegmonous erysipelas in a woman; (4) an abscess from a horse. One cubic centimetre of a twenty-four hours' old broth from each case was injected into the peritoneal cavity of a rabbit, and a large loopful of a twenty-four hours' old agar cultivation from each case was inserted under the skin of a mouse. In none of the cases obtained from the human subject were the animals affected, while the rabbit inoculated with the cultivation from the horse, died of septicæmia in twenty-four hours, and the mouse in two days.

Almost all observers have noted a great difference in the virulence of streptococci to animals even when taken from apparently similar cases in the human subject.

Marmorek has shown that streptococci obtained from various diseases in the human subjects, although differing initially in pathogenic effects on animals, can, nevertheless, be raised to the same pitch of virulence by repeated passages and cultivation in special media. He consequently looks upon the streptococci pathogenic to the human subject as all simple varieties of the same species which can be converted into one uniform type by appropriate means.

Lingelsheim was the first to point out that the streptococcus obtained from the normal mouth differed from the streptococcus longus in three points. It was not pathogenic to rabbits or mice; it rendered broth turbid, and the chains in this latter medicine were shorter than those of the streptococcus longus; and it caused slight liquefaction of gelatine. He considered it a distinct species and called it the streptococcus brevis.

His observations have been confirmed by some investigators, while others have disputed his view. We have made a careful series of cultivation and inoculation experiments with streptococci obtained from the mouths of three healthy individuals, and have compared them with streptococci obtained from cases of pyæmia and phlegmonous erysipelas.

The details of the experiments we will not weary you with, but will only give you the main

results. The streptococcus from the normal mouth differs from the streptococcus longus in the following points: (1) It is non-pathogenic when tested upon rabbits and mice; but we have already stated that this test of virulence in the case of streptococci is not very conclusive. (2) It produces a uniform turbidity in broth cultivations. (3) It clots milk and produces much more acid than the streptococcus longus. (4) The individual cocci are smaller, and the chains, especially in broth cultivations, shorter. The length of the chains is not always a reliable criterion. Sometimes in the impure cultivation obtained from the mouth the chains are very long, and this is probably due to the medicine being altered in composition by the other bacteria present.

We have not been able to confirm the observations of Lingelsheim that gelatine is liquefied.

Slight differences have been observed in the streptococci we have examined. Two of them grow more slowly in the cold than the other and present somewhat different microscopical appearances. The cultivations we are passing round illustrate these different points (*vide* also figs.).

The conclusions which we draw are these:— The streptococcus occurring normally in the mouth, agrees with the streptococcus brevis of Lingelsheim, and can be distinguished from the

streptococcus of disease by its biological and morphological characters. It must be looked upon as a distinct species for the present, although ultimately this view may be proved incorrect, for it is possible that further researches may enable us to convert the streptococcus brevis into the streptococcus longus. This, however, has hitherto not been accomplished. We think that the discrepancies of different observers who have investigated the streptococci of the mouth are partially due to the fact that the streptococcus longus is some times accidentally present and has been mistaken for the normal streptococcus of the mouth.

Discussion.

Dr. H. E. Durham said the Society ought to be very grateful to Dr. Washbourn and Mr. Goadby for the careful work they had done in separating the different varieties of streptococci. There was no doubt that at the present time streptococci were extremely important in infective pathogenic processes in man, especially now that the method of treatment by the serum of animals had shown itself to be so useful. They were all aware that serum prepared by means of streptococci had been prepared and largely used already. A certain number of cases which had been treated had not responded at all; in other cases the effect of giving an injection of anti-streptococcic serum had been most marvellous. He thought it clearly pointed to the fact that the streptococci which were present in various pathogenic conditions in man were not of one and the same species, and it was distinctly an advance to have classified some of the various kinds of streptococci.

Mr. Packes said that Mr. Goadby had taken several cultivations from his mouth, and he believed some of the cultures which had been shown that evening had been taken from his own carious teeth. He agreed with Dr. Washbourn that there were gentlemen who were certainly not as careful with their instruments as they might be.

Mr. Peters asked whether any relation existed between the acid producing streptococci and caries of the teeth.

Mr. J. H. Mummery said with regard to the pathogenic effect of the streptococci of the mouth, there was a paper by M. Gallipe, published in Paris, in which he described a case of endocarditis definitely due to infection from the mouth. The paper was amongst a collection of the author's papers which were published quite recently. Mr. Mummery thought too much attention could not be drawn to the question of the antiseptic treatment of instruments. He thought that many dental surgeons were not careful enough in that matter. The only safe way, in his opinion, was to put the instruments into boiling water as soon as they were done with. He would like to know whether the alteration of the appearance of the cocci, the oval and round cocci, was

not due to alteration in the nutrient condition of the medium in the mouth. Sometimes there was a diminution of the nutritive power, and then transition forms were obtained and not typical forms. He thought that Dr. Miller had stated with regard to the pneumonia bacillus that it was nearly always present in the mouth, and that it was very easily killed. It succumbed much more easily to certain antiseptics than most of the other organisms. In experiments with saccharine and benzoic acid Dr. Miller found that that was one of the first organisms destroyed.

Dr. St. Clair Thomson said he was very anxious to hear what became of all the bacteria in the mouth, and he might be excused a moment if he referred to what he found became of the bacteria in the nose. He found the majority of the bacteria inhaled were stopped at the entrance of the nose, and the remainder stuck to the gluey mucus lining the cavity, whence they were rapidly turned out by the ciliated epithelium. Some continental observers claimed the mucus of the nose to be distinctly bactericidal. It had even been asserted that it could kill the spores of anthrax. He and a colleague of his, Dr. Hewlett, had tried over and over again to confirm that fact, but they completely failed. However, they found it had one distinct virtue, viz., that it inhibited the growth of bacteria, which was, of course, something in the same direction, but was different from bactericidal action. It seemed to him that there was no need for the mucus to be bactericidal, because the germs, as they landed on the mucus of the nose, were prevented from developing and then expelled by the ciliated epithelium. While studying the bacteria of the nose he had been astonished at the swarms of organisms that were met with in the cleanest of mouths. Dr. Washbourn had said that the saliva was germicidal. He should like to know whether the saliva was sufficient to meet those hordes of bacteria. He would suggest that the bacteria were wrapped up in the saliva, and when thus rendered inoffensive were swallowed. He was anxious to learn Dr. Washbourn's views as to the fate of all the organisms in the mouth. He would also like to know

if it had occurred to Dr. Washbourn whether the bacteria were present in greater quantities in mouth breathers.

Mr. Storer Bennett said a remark had been made by a member with regard to the acid generating powers of the streptococci, the probability being suggested that those organisms had the power of generating acids that might be the cause of caries. Mr. Bennett thought that was an erroneous view, because Dr. Washbourn had distinctly stated that the streptococci were always present in the mouths of the healthy as well as the mouths of diseased persons—in the mouths of those people who had absolutely no decayed teeth, as well as in those who had a large number. Therefore it was obvious that although they might generate a certain amount of acid, it was not fair to jump to the conclusion that the acid generated by them was the acid capable of producing caries. It was obvious to all of them he thought, who were familiar with the work of Dr. Miller and others working in connection with caries of the teeth, that much more was necessary to produce caries than these streptococci, even though it might be true they had the power of generating acid.

Mr. Sidney Spokes said he was reminded by Dr. Washbourn's allusion to puerperal fever, that one of the members of the Society had placed upon record certain instances which he thought might point to the infection in puerperal fever being derived from the nurse's mouth. The nurse—he did not mean the modern nurse, but a nurse of the "Sairey Gamp" character—might be suffering from an alveolar abscess, and unconsciously might press the tender tooth with her hand, and inoculate the puerperal patient. From what Dr. Washbourn had said, the streptococci need not come from the abscess itself; any irritation might lead the nurse to put her finger into the mouth and convey some of the streptococci Dr. Washbourn had told them about into the vagina of the patient.

Mr. Goadby, in reply, said that Mr. Durham had given him personally a good deal of help in the matter. With regard to the classification of the streptococci, the point was that in various common media the streptococcus brevis

gave a good many different reactions. They could not simply take the morphology of the two streptococci and say one was the brevis and the other the longus. They must cultivate on all the various media and get the different reactions—clotting of the milk, the growth on the gelatine, &c. They grew very badly on gelatine and on potato. On potato both of them involuted a great deal, but he thought the streptococcus longus involuted the least. Mr. Peters had said something about the acid production, and Mr. Storer Bennett, he thought, had the idea that he (Mr. Goadby) meant that caries was produced by the acid of the streptococci alone.

Mr. Storer Bennett said that was what he inferred from the earlier remarks.

Mr. Goadby said with regard to that point nine-tenths of the bacteria produced acid, and all they wished to point out was that the streptococci found in the mouth did produce acid and the pathogenic ones did not.

Dr. Washbourn also replied, he said that Dr. Durham had referred to the serum treatment of streptococcal infections. A very good case came under his care, the case of a boy who shortly after the removal of a tooth was taken with severe symptoms of septicæmia and cerebral disturbance. They felt quite satisfied that he had some commencing meningitis, and also that the probability was that it was due to a streptococcal infection. A little of the pus from the tooth was examined and streptococci were found. Unfortunately they did not test the virulence, nor did they make a careful series of cultivations in order to see whether it was the streptococcus longus or some of the streptococci from the mouth which had accidentally entered into the tubes. They treated the case with serum with most remarkable results; very soon after the injections the boy got better and ultimately completely recovered. With regard to the case of ulcerative endocarditis, that occurred from infection through the mouth, he had no doubt that the pathogenic streptococci were sometimes present in the mouth and that septicæmia might be produced in that way when any wound of the mouth occurred. As to the shape of the cocci, they varied according to the medium

in which they were cultivated. In comparing any micro-organisms, of course the cultivation should be made under exactly similar circumstances, and when they stated that the individual cocci were smaller in the streptococci brevis than in the streptococci longus, they meant when they were cultivated upon broth having exactly the same composition. As a matter of fact, if the streptococci were cultivated upon potato, the cocci became elongated and looked like bacilli. With regard to the presence of pneumococcus in the mouth, there were very many observers who said it was almost constantly present, but he had some doubts as to whether those observers had not sometimes mistaken the streptococcus for the pneumococcus. Dr. Thomson asked what became of the bacteria of the mouth. He (Dr. Washbourn) had no doubt that some of them were destroyed by the saliva, and that others were swallowed and were destroyed by the gastric juice. The gastric juice had fairly good antiseptic properties. As to whether there were more bacteria in the mouths of those who breathed with their mouths open, no experiments had been made. Puerperal fever might arise from any septicæmic conditions such as the one which was referred to; in an alveolar abscess there were virulent streptococci, and those might very well have produced the disease.

A vote of thanks was accorded to the authors for their paper.

The PRESIDENT having announced that the office bearers nominated by the Council had been unanimously approved, delivered the following valedictory address:—

GENTLEMEN,—Were I to refer, as I would like to do, to the various unavoidable changes which have taken place, I should be trespassing on the province of gentlemen who will presently have something to say on this head, but at least I may be permitted to express my opinion generally, that a peculiar fitness seems to mark the various official posts as they have this night been filled, and the Society is to be heartily congratulated on a list of office bearers so well qualified to carry on its important work and make arrangements for its scientific and other requirements.

The future being thus happily provided for, it behoves me to say one word of the immediate past, and I assure you, gentlemen, my only feeling is one of gratitude for the unfailing support you have accorded to myself and my colleagues during our official year.

At the commencement of the session, I ventured to express the hope that it might be one of profit, not only to ourselves but to the profession at large, and that hope I feel bound to say has been amply realised.

At our opening meeting an animated and interesting discussion took place on "The Immediate Regulation of Misplaced Teeth," a subject opened up at the close of the previous session by a paper from Mr. Cunningham, and a communication illustrated by a series of instructive models, by Mr. Spokes. The boldness of the processes suggested was somewhat alarming, more particularly the heroic measure adopted by Mr. Cunningham, of dividing the alveolus; but much interest was aroused, and it may be encouraging to those who are now experimenting in this direction, to know that as far back as the year 1750, a somewhat similar method of treatment was largely practised by one Mons. Bourdet, of Paris, and with evident success.

Mons. Bourdet, in his work on Dental Surgery, which was published in 1786, quotes various instances of the treatment of obstinate irregularities by this method. An instrument called "The Pelican," a species of key specially adapted for the purpose, was employed to forcibly draw the offending tooth into place. This accomplished, it was retained by ligatures until the healing process was complete. Mention is made of the free use of the file where sufficient space did not exist, but it is not clear that the file ever penetrated the alveolus. The "pelican," however, as a study of its construction shows, no doubt effected in a cruder and harsher way, a somewhat similar object to that attained by the delicate revolving saw employed by Mr. Cunningham.

It is also interesting to note that Mons. Bourdet was an advocate for the removal of the six-year-old molars, for

in one case quoted by him, he tells how from a crowded mouth he removed, in spite of the remonstrances of the parents, the four first molars, only two of which were decayed, and after having watched the case for a few years, pronounced the satisfactory verdict that "Cette demoiselle a présentement les plus belles dents du monde."

Mons. Bourdet's treatise in two volumes is teeming with valuable information and interesting matter. He was a keen advocate for the replantation of teeth, and remarks quaintly, if I may venture to translate him, that a good dentist can as safely replace a tooth as a clever gardener can transplant a young tree. He takes some credit to himself for perfecting this particular operation, the origin of which, however, he points out is buried in obscurity, and quoting from the writings of one Denis Pomaret, a surgeon of Montpellier, he gives an account of the operation as it was performed more than a century before his own time.

To return then to our opening meeting, two cases in practice were brought forward, one of "Ptosis of Dental Origin," and one of "Fracture of the Maxillary Tuberosity during the Operation of Extraction." Mr. Main Nicol's clear and lucid report of these cases rendered them highly interesting, and the value of such communications cannot be over-estimated. Mr. Boyd Wallis's contribution on "The Antiseptic Properties of Perchloride of Mercury," was a valuable addition to our knowledge of the properties of this drug.

If I may continue a brief and rapid *resumé* of some of the subjects treated of during our session, I must not omit to mention Mr. Leonard Matheson's excellent paper dealing ably with many points in practical dental surgery, and the prolonged and healthy discussion that ensued thereon; also the friendly controversy between Dr. Miller, of Berlin, and Mr. F. J. Bennett, on "The Transparent Zone in Decay" which occupied a portion of the same evening. I must also recall the communication from Dr. Dentz of Utrecht, entitled "An Anomaly of the First Upper Temporary Incisor and its Morphological Significance," which was read by our foreign secretary and Past President, Mr.

Mummery. Some apology I feel is due to Dr. Dentz, for the subject of his communication not being discussed at the time, but the absence of the excellent illustration which is now to be found accompanying the paper in our January Transactions rendered this impossible.

Dr. Dudley Buxton's classic paper on "The Nature of Anæsthesia," comes next on our list, and it has since been reprinted in the *Lancet* by permission of the Council of this Society. I feel sure all interested in this subject will do well to take to heart two, at least, of its many practical lessons. I refer to a passage where the author says: "In general we must conclude that the action of an anæsthetic should be restricted within those clearly defined limits which involve only the higher ganglionic centres," and further, "that under no circumstances should incomplete anæsthesia be deemed sufficient for even the most trivial operation."

To Mr. Charles Tomes we are deeply indebted for three invaluable contributions. Firstly, the account of his elaborate experiments on the composition of dentine and enamel, explained by him to the Society in February. Secondly, for his "Further Experiments on the Nature of Amalgams," and thirdly, for his remarkable communication entitled "A Case of Calcification of a Widely Exposed Pulp," which was so admirably illustrated by photographs taken by Mr. Mummery.

Mr. Tomes' experiments on the chemical composition of enamel, which he has clearly proved contains practically no organic matter, are fully described in the *Journal of Physiology*, vol. xix., No. 3, for 1896, and if read in conjunction with the February number of our Transactions, some idea may be gained of the painstaking and elaborate investigations which this keen observer is pursuing. With regard to the amalgam experiments, Mr. Tomes expressed the hope that the subject might be taken up by others, and I believe I am correct in stating that several members of the Society are now engaged in carrying out experiments in this respect, on somewhat similar lines to those laid down by him.

The evolution of the mammalian dentition is a subject ever enthralling to odontologists, and this was brought before the Society in a masterly way by Dr. Marratt Tims. The paper, which provoked an instructive discussion, in which Mr. A. Smith Woodward of the Natural History Museum and other gentlemen took part, formed the subject of a leading article in the March number of the *Journal of the British Dental Association*. The beautiful and numerous lantern slides with which Dr. Marratt Tims' paper was illustrated were prepared by our Past President, Mr. Charters White, whose skill in scientific photo-micrography is so well known and appreciated.

Mr. A. Marmaduke Shield's paper on "A Case of Aneurism by Anastomosis, involving the Vessels of the Hard Palate," was one of extreme interest to dental surgeons, showing as it did the urgent necessity of a careful diagnosis being made of growths of a vascular nature before attempting surgical treatment. His remarks also on recurrent hæmorrhage in the mouth are worthy of careful consideration.

Amongst many communications brought forward by our indefatigable curator, Mr. Storer Bennett, perhaps the most noteworthy is his report on "A Case of a Reunited Fractured Human Tooth, with some Remarks on the Healing of Wounds of the Dental Pulp." The microscopic and other conditions of the unique specimen which suggested this communication, and which was presented to the Society in 1888 by Mr. W. E. Harding, are now beautifully illustrated in a series of photographic reproductions in our April Transactions, where they will be found of infinite value, and I may here say that during the past session a considerable outlay has been incurred by the various illustrations which have appeared from time to time. The illustrations, however, have been produced in the most perfect manner, they render the Transactions doubly valuable for reference purposes, and the Council has felt fully justified in sanctioning the necessury expenditure.

Following a wise precedent, one of our evenings was set apart for an open discussion. Mr. J. F. Colyer, who kindly

undertook to open this discussion, was fortuitous in his choice of a subject, namely "The Early Treatment of Crowded Mouths," and the lively discussion which ensued on Mr. Colyer's opening remarks is still fresh in our memories. The subject was one which will, I believe, be discussed for many years to come, even as Mons. Bourdet and his contemporaries discussed it 150 years ago, but I firmly believe that each free and full discussion brings us nearer to that time when we shall be able, more exactly than we do at present, to discriminate between those cases where nature can and nature can*not* effect the cure, and indicate the best period for the weeding process, even when that must extend to the germs of the partially formed teeth themselves. Mr. Charles A. Clark has recently exhibited to the Society photographs showing the roots of the teeth taken by means of the "X" rays. May this not show the way to a means of diagnosis in this direction?

To-night we have listened to another valuable addition to our scientific papers of the year. Dr. Washbourn has brought before us, in a most lucid and interesting manner, many points in connection with the bacteria of the mouth. To Dr. Washbourn and Mr. Goadby, with whom he has collaborated, we are much indebted. The discussion which has taken place is a better compliment than any I can offer, so I will here merely tender to these gentlemen the best thanks of the Society.

Time will not permit me to dwell upon Dr. Martin's "Prothese Immediat," exhibited and explained by Mr. Blain; Mr. George Brunton's experiments in colouring porcelain gum bodies and enamels; Mr. A. S. Underwood's and Mr. Bond's cases of nasal replacement, and many other interesting casual communications which have come before us, but this hasty *resumé* will serve to remind us of some, at least, of the various topics which have engaged our attention and served as our mental pabulum during the session that is past. Viewing them impartially, they appear, in scope and character, in all respects worthy of our Society's highest aims.

Gentlemen,—Three days ago I had determined to say

nothing this evening but a word of farewell. In spite of my better self, however, I have been tempted into offering these few desultory remarks, and for their imperfections, in view of their hasty preparation, I must offer you my humble apologies. You must take them merely as an evidence of the lingering regret which attaches to the severance of pleasant ties and the relinquishing of an honourable position.

In vacating this chair I carry with me a legacy of never-to-be-forgotten memories, and the recollection of many evenings profitably spent. I have only one legacy to bequeath in return, but it is one which I feel sure you, my fellow-members, will be glad to receive. It is an ancient volume containing a copy of the invitation signed by Mr. Samuel Cartwright, Mr. John Tomes, and Mr. Thos. Arnold Rogers, and some fifty autograph letters written in response thereto, by the early members joining this Society prior to the adoption of the election by ballot in 1856. It moreover, contains fragments of the correspondence with the Royal College of Surgeons, which led up to the foundation of the Dental Diploma. It contains also some original and amended drafts of that diploma and many other documents of historic interest. Its fitting home is the library of this Society, and in the hands of our trusty librarian, Mr. Maggs, it will be in safe keeping. It is with great pleasure that I entrust it to his care.

Having thus recalled the foundation of the Odontological Society of Great Britain, which took place forty years ago, I will express my parting wish that it may long continue to flourish and prosper.

Mr. Hutchinson proposed a vote of thanks to the President, for his address, and for his services in the Chair during the past Session, which was carried by acclamation.

Mr. Hutchinson said, that Mr. Hepburn was so well known to all of them, and so deservedly and universally popular, that any words of his would be superfluous, but it was only right that their sincere congratulations should be offered, not only to the President, but to the Hon. Secretaries, for the very interesting and valuable series of

papers and communications which had been provided, especially as they embraced almost every branch of practical and scientific dental surgery, and besides this, several papers had dealt more particularly with collateral surgical matters of much importance.

Mr. Hutchinson alluded to the interesting fact that so many Presidents of the Society had been followed in due course in the Chair, by their sons; and he was proud to say that no charge of nepotism could be laid at their doors, as all the sons had richly earned their high position, independently of their distinguished fathers; and of these he would mention Mr. Cartwright, Mr. Rogers, Mr. Tomes, Mr. Mummery, Mr. Hepburn, also Mr. R. H. Woodhouse, whose uncle has been President.

Mr. Hutchinson spoke feelingly of his first visit to the Society when a student, for Mr. Hepburn's father was then President; and it must be gratifying to them all to know that Mr. Hepburn, senior, was still amongst them, and it must be very gratifying to him to see his son so highly esteemed, and so worthily maintaining the best traditions of a Society which had done so much to promote the progress and honour of the dental profession, and to its pioneers their best devotion was due.

The vote of thanks was carried with acclamation.

The PRESIDENT briefly responded.

Mr. MUMMERY moved that a hearty vote of thanks should be given to Mr. Hutchinson for all he had done for the Society. Mr. Hutchinson had been really holding office for many years. He began as Secretary in 1879, was Curator from 1881 to 1885, Vice-president till 1888, President in 1891, and had been Treasurer for the last three years.

The motion was carried with acclamation.

Mr. HUTCHINSON having briefly replied,

Mr. BRUNTON moved that the best thanks of the Society should be given to the Council and the Officers, which motion was also carried with acclamation, and Mr. COLYER replied.

The following members were elected as officers and councillors for the ensuing year :—

PRESIDENT.

R. H. Woodhouse.

VICE-PRESIDENTS.

Resident : John Fairbank, C. J. B. Wallis, John Ackery.
Non-Resident : George Henry (Hastings), J. F. Cole (Ipswich), Malcolm Macgregor (Edinburgh).

TREASURER.

W. H. Woodruff.

LIBRARIAN.

W. A. Maggs.

CURATOR.

Storer Bennett.

EDITOR OF TRANSACTIONS.

J. F. Colyer.

HONORARY SECRETARIES.

J. H. Mummery (*Foreign*), C. Woodhouse (*Council*), H. Baldwin (*Society*).

COUNCILLORS.

Resident : J. Gartley, C. Robbins, S. Spokes, A. Smith, G. D. Curnock, H. J. Gould, J. O. Butcher, H. L. Albert, H. J. Kluht.

Non-Resident : T. Arkovy (Budapest), A. W. W. Baker (Dublin), F. E. Huxley (Birmingham), G. Cunningham (Cambridge), C. B. Mason (Scarborough), J. J. Andrew (Belfast), E. N. Washbourne (Ripon), J. S. Amoore (Edinburgh), W. R. Ackland (Bristol).

INDEX.

A.

Address, inaugural, 11; valedictory, 266

Albert, Mr. H. L., on ptosis, 6; on the immediate regulation of teeth, 25; present of model of displaced upper central, 33; on a case of aneurism by anastomosis, 171

Amalgams, further notes on, by Mr. C. S. Tomes, 193

An anomaly of the first upper temporary incisor and its morphological significance, paper by Dr. Dentz, 75

Anæsthesia, a paper on the nature of, by Dr. Dudley Buxton, 83

Aneurism by anastomosis, paper by Mr. A. M. Sheild, on a case of, 171

B.

Bacteria of the mouth, some points in connection with the, 242

Badcock, Mr. J. H., on the immediate regulation of teeth, 19; on Mr. Matheson's paper, 67

Baldwin, Mr., on Mr. Matheson's paper, 69; on the origin of the mammalian teeth, 166; on amalgams, 205; on the early treatment of crowded mouths, 222

Balkwill, Mr., elected honorary member, 121

Bambridge, Mr. H., elected, 73

Bennett, Mr. F. J., on ptosis, 5; on the immediate regulation of teeth, 24; on Dr. Miller's paper, 40; on an anomaly of the first upper temporary incisor, 81; on the origin of the mammalian teeth,161; on amalgams, 205

Bennett, Mr. Storer, on the nature of anæsthesia, 106; on the injudicious use of elastic bands, 138; report on a case of reunited fractured human tooth, 181; on the early treatment of crowded mouths, 229; on bacteria of the mouth, 264

Blain, Mr., on Dr. Martin's "Prothese Immediat," 141

Bowden, Mr. G. H., elected, 169; admitted, 211

Brunton, Mr. G., note on some experiments in colouring porcelain for teeth and gum bodies or enamels, 211; on the early

treatment of crowded mouths, 223
Buxton, Dr. D., on the nature of anæsthesia, 83

C.

Calcification of a widely exposed pulp, paper by Mr. C. S. Tomes on a case of, 183
Catt, Mr. E., elected, 109; admitted, 137
Chambers, Mr. T. R., elected, 169; admitted, 211
Colyer, Mr. J. F., on very rapid decay in young child, 79, 82; on the practical use of "Prothèse Immediat," 142; on the early treatment of crowded mouths, 215, 230
Cornelius, Mr. W. F., elected, 109, admitted, 137
Cunningham, Mr., on the immediate regulation of teeth, 18, 28; on amalgams, 206; on the early treatment of crowded mouths, 225
Curator's report, 73, 110, 137, 170, 238

D.

Davis, Mr., exhibition of an artificial nose, 143
Dentine and enamel, notes on, 114
Dentz, Dr., paper entitled "An anomaly of the first upper temporary incisor and its morphological significance," 75
Dodd, Mr. F. L., elected, 109
Dudley, Mr. E. L., elected, 109; admitted, 137
Durham, Dr. H. E., discussion on bacteria of the mouth, 262

E.

Early treatment of crowded mouths, discussion on the, 215
Election of members:—
Hoffmann, Mr. A. W. W., Wallace, Mr. J. S., 1
Bambridge, Mr. H., 73
Dodd, Mr. F. L., 109
Nowell, Mr. W. S., 109
Catt, Mr. E., 109
Cornelius, Mr. W. F., 109
Dudley, Mr. E. L., 109
Matthews, Mr. H. D., 137
Bowden, Mr. G. H., 169
Chambers, Mr. T. R., 169
Prideaux, Mr. C. S., 235

F.

Fractured human tooth, report on a case of, by Mr. Storer Bennett, 181

G.

Gartley, Mr., present of model showing supernumerary teeth, 74
Gill, Mr. B., on Mr. Matheson's paper, 68; on an anomaly of the first upper temporary incisor, 81
Goadby, Mr., on the chemistry of dentine and enamel, 134; paper on some points in connection with the bacteria of the mouth, 242; reply to discussion on his paper, 264
Gregson, Mr., death of, 110

H.

Hern, Mr. W., on the immediate regulation of teeth, 18; on Mr. Matheson's paper, 66
Hewitt, Dr., on the nature of anæsthesia, 107
Hoffmann, Mr. A. W. W., elected, 1
Hospital cases of immediate regulation of teeth, notes of certain, 22
Humby, Mr., on the immediate regulation of teeth, 28; on the

early treatment of crowded mouths, 227

I.

Immediate regulation of teeth, discussion on the, 18
Immediate regulation of teeth, notes of certain hospital cases of, 22
Inaugural address, 11
Ivory, specimens shown by Mr. Mummery, 74

J.

Jarvie, Mr. W., admitted a member, 2

K.

Kirby, Mr., on the immediate regulation of teeth, 18

L.

Librarian's report of additions to library, 2, 32; periodicals received, 74, 109, 137, 170, 211, 238; annual report of, 238

M.

Maggs, Mr. W. A., on the origin of the mammalian teeth, 164
Mammalian teeth, paper by Dr. Marett Tims on the origin of the, 145
Matheson, Mr. L., on fracture of the maxillary tuberosity, 5; on the immediate regulation of irregular teeth, 24; paper on a few practical points, 45; reply to discussion on his paper, 70
Matthews, Mr. H. D., elected, 137; admitted, 169
Maxillary tuberosity, fracture of the, 4
Miller, Dr. W. D., paper on the transparent zone in decay of the teeth, 35; discussion on, 40
Mummery, Mr., on Dr. Miller's paper, 43; showed specimens of ivory, 74; discussions on the chemistry of dentine and enamel, 135; on bacteria of the mouth, 262
Museum, present from Mr. W. B. Burrows of four old bone plates with natural teeth, and similar lower plate from Mr. M. Davis, 73; announcement of presentation by Mr. A. Farebrother of vulcanite plate of very primitive workmanship and four upper incisors, 73; presentation by Mr. M. Smale of skull of black antelope and skull of Panolia deer, 74; and also skull of crab-eating raccoon, 110; purchase of specimens, 110; presentation by Mr. B. Gill of model of three upper temporary laterals, 137; presentation by Mr. V. L. Hope of part of left half of mandible of cave bear, 138; presentation by Mr. W. F. Forsyth of two specimens of old bone work, and also of an ancient instrument for the extraction of teeth, 170; presentation by Mr. J. H. Whatford of model showing an interesting irregularity in the front of the mouth, 170; annual report of the, 238

N.

Nicol, Mr. M., on (1) ptosis of dental origin, 2; (2) fracture of the maxillary tuberosity, 4; reply to discussion on his paper, 7

Nose, artificial, described, and models exhibited, by Mr. Underwood, 111
Nose, artificial, exhibited by Mr. Davis, 143
Nowell, Mr. W. S., elected, 109; admitted, 137

P.

Paterson, Mr., on the origin of the mammalian teeth, 165; on a case of aneurism by anastomosis, 171; on amalgams, 208
Pedley, Mr. D., on Mr. Matheson's paper, 68; on the early treatment of crowded mouths, 228
Perchloride of mercury, note read by Mr. B. Wallis, 7
Porter, Mr. F. C., admitted a member, 32
Practical points, paper by Mr. L. Matheson, a few, 45; discussion on, 65
President, the inaugural address, 11; replies to the papers on the immediate regulation of teeth, 30; the transparent zone in decay of the teeth, 71; a few practical points, 71; the nature of anæsthesia, 107; on dentine and enamel, 136; the origin of the mammalian teeth, 168; further notes upon amalgams, 209; valedictory address, 266
Prideaux, Mr. C. S., elected, 235
"Prothese immediat," Dr. Martin's, specimens exhibited by Mr. Blain, 141
Ptosis of dental origin, 2

R.

Reinhardt, Mr., on discoloration from use of Miller's tabloids, 10; on amalgams, 206
Rilot, Mr. C., a case of football accident, 113
Robbins, Mr., on Mr. Matheson's paper, 65; on the early treatment of crowded mouths, 226

S.

Saunders, Mr., exhibition of instruments for scaling teeth,
Sheild, Mr. A. M., paper on a case of aneurism by anastomosis involving the vessels of the hard palate, 171; reply to discussion on his paper, 180
Spokes, Mr. Sidney, on the immediate regulation of teeth, 28; on the early treatment of crowded mouths, 224; on bacteria of the mouth, 264
Storey, Mr., on the early treatment of crowded mouths, 230

T.

Thomson, Dr. St. Clair, on bacteria of the mouth, 263
Tims, Dr. Marett, paper on the origin of the mammalian teeth, 145; reply to discussion on his paper, 167
Todd, Mr., present of portrait of M. Dechement, 32
Tomes, Mr. C. S., notes on dentine and enamel, 114; reply to discussion on his paper, 135; paper on a case of calcification of a widely exposed pulp, 183; further notes upon amalgams, 193; reply to discussion on his paper, 208
Tomlinson, Mr. J. W., admitted a member, 2
Transparent zone in decay of the teeth, paper by Dr. W. D. Miller on the, 35; discussion on, 40
Treasurer, report of, with balance sheet, 235

U.

Underwood, Mr., on the method of making an artificial nose, 111

V.

Valedictory address, 266
Vanderpant, Mr., on fracture of the maxillary tuberosity, 6: on Mr. Matheson's paper, 70; on an anomaly of the first upper temporary incisor, 81

W.

Wallace, Dr., present of half of the skull of a female tapir, 138
Wallace, Mr. J. S., elected a member, 1; admitted, 32
Wallis, Mr. Boyd, present of models showing supernumerary teeth, and model of growth at back of nose, 7; note on perchloride of mercury, 7; exhibiting tray for annealing gold for filling purposes, heated by electricity, 241
Washbourn, Dr., paper on some points in connection with the bacteria of the mouth, 242; with reply to discussion on his paper, 265
White, Mr. C., present of specimens of old bone work, 32
Williams, Mr. E. Lloyd-, on the immediate regulation of teeth, 26
Williams, Mr. Leon, on the chemistry of dentine and enamel, 133
Woodhouse, Mr. R. H., exhibited model of fracture in bicuspid region, 112; on the early treatment of crowded mouths, 220
Woodward, Mr. A. S., on the origin of the mammalian teeth, 162

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LIST OF ILLUSTRATIONS.

PLATES—

An anomaly of the first upper temporary incisor, 80.

Six photo-micrographs showing:—1, Transparent zone extending quite to the pulp cavity. 2, Transparency where the enamel of the cusps has been worn down and no caries is present. On the right a transparent cone resulting from a defect in the enamel, caries from the centre of the grinding surface encroaching on the transparent zone, yet the latter has to some extent retained its integrity. 3, Decalcification of the dentine in caries advancing in a regular line. 4, Transparent zone with and without caries. Transparent band extending to the pulp cavity. 5, Caries —showing transparent and opaque zones. 6, Transparency of the dentine due to cracks in the enamel, 88.

Four photo-micrographs showing:—Fig. 1, Scrapings from the enamel of a young elephant molar, calcined. This shows isolated enamel prisms, which differ only from similar scrapings before being calcined in that the prisms have become more opaque and granular. Fig. 2, Section of shell of Pinna cut transversely to the prisms. Fig. 3, Section of shell of Pinna which had been ground thin, cemented to the glass and decalcified *in situ*. It shows the connective tissue reticulum in which the prisms were deposited, and the walls of the honey comb are in places seen in perspective, showing their depth in the thickness of the section. Fig. 4, Isolated prism of Pinna shell. This shows very distinctly the transverse striation of an individual prism, 127, 131.

Case of suppression of the upper permanent incisors in an almost full-grown monkey; Case of the absence of left upper permanent incisor in an adult monkey, 140.

Three photo-micrographs:—Fig. A., Case of fractured and reunited upper incisor. Section including the seat of fracture, and showing uniting tissue. Fig. B, Magnification of the

central portion of uniting tissue seen in Fig. A. Fig. C, Still further enlargement of uniting tissue than seen in Figs. A and B. Fig. D, The two outer surfaces of tooth from which the section (Fig. A) was removed. The leathery uncalcified uniting portion is well shown at the spot marked by the arrow. Fig. E, The inner surfaces of the preceding figure (Fig. D), and from between which the microscopic section (Fig. A) was removed. The communication is well seen in the section marked by the arrow, 182.

Eleven photo-micrographs illustrating a case of calcification of a widely exposed pulp, 192.

Six photo-micrographs showing:—Fig. 1, *Diplococci* in and around epithelial cell from normal healthy mouth (direct) × 1,500. Fig. 3, *Bacillus maximus buccalis* from healthy mouth (direct) × 1,000. Fig. 4, *Spirillum Sputigenum* from healthy mouth (direct) × 1,000. Fig. 5, *Spirochæta Dentium* from healthy mouth (direct) × 1,000. *Streptococcus brevis* from healthy mouth (cultivation) × 1,000. *Streptococcus longus* from fatal case of pyæmia (cultivation) × 1,000, 250.

ODONTOLOGICAL SOCIETY OF GREAT BRITAIN.

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NOTE.—According to Bye-Law V., this form must be signed by four Members, two at least from personal knowledge, for the recommendation of a Resident Member; and by three Members, one at least from personal knowledge, for the recommendation of a Non-Resident Member.

Name _____

Place of Residence _____

Professional Qualification _____

_____

_____

being desirous of becoming a Member of the ODONTOLOGICAL SOCIETY OF GREAT BRITAIN, we, the undersigned, recommend him as well qualified to promote the objects of the Society.

From Personal Knowledge.	*From General Knowledge.*
	1. Submitted to Council _____
	2. {Approved by Council / Proposed to Society}
	3. Suspended _____
	4. Elected _____